ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES

A THESIS SUBMITTED TO
BABA FARID UNIVERSITY OF
HEALTH SCIENCES, FARIDKOT (PUNJAB)

IN THE PARTIAL FULFILLMENT
FOR THE AWARD OF DEGREE OF
DOCTOR OF MEDICINE
IN
RADIODIAGNOSIS

2024

Submitted By
DR. SANCHI BAGHLA

DEPARTMENT OF RADIODIAGNOSIS
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled "**ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES**" submitted towards partial fulfillment of the requirements for the award of **MD in RADIODIAGNOSIS** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Kamini Gupta**, Professor, Department of Radiodiagnosis, **Dr. Kavita Saggar**, Professor & Head, Department of Radiodiagnosis. No part of this thesis has formed the basis for the award of any degree previously.

_____

Dr. Sanchi Baghla
Department of Radiodiagnosis
Dayanand Medical College & Hospital,
Ludhiana, Punjab

Date:

Place:

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES"** exist in the Department of Radiodiagnosis, DMC&H, and Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate herself under our supervision and guidance.

Supervisor

Dr. Kamini Gupta
Professor
Department of Radiodiagnosis
DMCH, LUDHIANA

Co-Supervisor

Dr. Kavita Saggar
Professor and Head
Department of Radiodiagnosis
DMCH, LUDHIANA

Date:

ENDORSEMENT BY THE HEAD OF THE INSTITUTE

This is to certify that the thesis entitled **"ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES"** is a bonafide research work done by **Dr. Sanchi Baghla** under the supervision of **Dr. Kamini Gupta**, Professor, Department of Radiodiagnosis and **Dr. Kavita Saggar**, Professor & Head, Department of Radiodiagnosis, in this institution.

Principal

Dr. GS Wander
Principal
DMC&H, Ludhiana

Date:

COPYRIGHT

Declaration by the Candidate

I hereby declare that the Baba Farid University of Health Sciences, Faridkot, shall have the rights to preserve & use this thesis in print or electronic format for academic/study purpose by the research scholar/students.

Signature

Dr. Sanchi Baghla
Department of Radiodiagnosis
Dayanand Medical College & Hospital,
Ludhiana, Punjab - 141001

Date:

© Baba Farid University of Health Sciences, Faridkot

Dedicated

to

my Family,

friends

&

Teachers

ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to everyone who has supported and guided me throughout the course of my thesis. Their contributions have been invaluable and deeply appreciated.

First and foremost, I would like to thank the Almighty who has always showered his blessings on me.

I am profoundly grateful to my parents, Mr Pawan Baghla, Mrs Ritu Baghla, Dr Gurmeet Walia and Mrs Vaneet Ahluwalia whose love and support have been my foundation. Your encouragement has been a constant source of strength and your dedication to my education has made this achievement possible I owe my perseverance and determination to the values you have instilled in me. I want to express my gratitude to my husband, ***Dr. Kunal Singh Ahluwalia****, who has been my pillar of strength. Without his guidance, this task would have remained incomplete. Thank you for your patience, understanding, and encouragement throughout this journey.*

I express my profound gratitude to my esteemed teacher and mentor, ***Dr. Kamini Gupta,*** *Professor, Department of Radiodiagnosis, DMCH. Your expertise, patience, and insightful guidance have been pivotal in shaping this research. Your unwavering support and encouragement have guided me through the most challenging phases of this journey. I am sincerely grateful for the time and effort you invested in mentoring me and for continuously urging me to pursue excellence. I feel privileged and honoured to work under such an illustrious guide and teacher.*

I am deeply thankful to my respected co-supervisor, ***Dr. Kavita Saggar,*** *Professor and Head of the Department of Radiodiagnosis at DMCH, for their invaluable contribution, continual assistance, and guidance throughout this journey.*

*This piece of work would have been incomplete without the help and support of my teachers**, Dr. Archana Ahluwalia, Dr. Ritu Galhotra, Dr. Chandan Kakkar and Dr. Devinder Pal Singh Dhanota** who have always encouraged and guided me throughout my post-graduation period.*

I would like to thank my friends and juniors for helping me in periods of distress throughout my post-graduation period.

My special thanks to the entire technical staff of DMCH who provided me with all the valuable help.

I am extremely thankful to all the patients and volunteers who participated in this study.

Dr. Sanchi Baghla

ABSTRACT

Introduction: Multidetector computed tomography is an important tool in detection and characterization of bowel abnormalities and allows assessment of mural and extraluminal abnormalities. The various causes of bowel wall abnormalities include neoplastic, infectious, inflammatory and ischemic conditions.

AIM OF STUDY:

1) To characterize the ileocaecal pathologies on MDCT abdomen.

2) To correlate MDCT findings with clinical, endoscopy findings and histopathology wherever possible

Materials and Methods: A prospective study of 30 patients (16 M;14 F, Age range: 9-74 years) undergoing Multidetector contrast-enhanced CT for ileocaecal pathology at the Department of Radiodiagnosis, Dayanand Medical College & Hospital, Ludhiana over a period of 1.5 year.

Results: Out of 22 cases with benign diagnosis on CECT, 19 (86.4%) cases proved to be benign on final diagnosis. Out of 4 cases with malignant diagnosis on CECT, 3 (37.5%) proved to be malignant on final diagnosis. Out of the remaining 4 cases which could not be confirmed on CECT as benign/malignant, 2 (9.1%) were benign and 2 (25.0%) were malignant on final diagnosis. Hence, CECT is an important differentiator between benign and malignant etiology of ileocaecal wall thickening when compared with the final diagnosis (p= 0.020). The diagnostic accuracy of CECT in the detection of ileocaecal pathologies came out to be 84.62%.

Conclusion: MDCT is an ideal imaging modality for differentiating between benign and malignant aetiology of Ileocaecal thickening. Majority of the patients with ileocaecal wall thickening on MDCT have an underlying disease and should be further investigated by ileocolonoscopy.

Keywords: Multidetector computed tomography (MDCT), ileocaecal thickening**.**

ABBREVIATIONS

MDCT	Multidetector computed tomography
CT	Computed tomography
CECT	Contrast enhanced computed tomography
CTE	Computed tomography enterography
MR	Magnetic resonance
TB	Tuberculosis
CD	Crohn’s disease
IBD	Inflammatory Bowel Disease
IC	Ileocaecal
PPV	Positive predictive value
NPV	Negative predictive value

TABLE OF CONTENTS

S. NO.	TOPIC	PAGES
I	INTRODUCTION	1-8
II	AIMS AND OBJECTIVES	9
III	REVIEW OF LITERATURE	10-21
IV	MATERIALS AND METHODS	22-24
V	OBSERVATIONS AND RESULTS	25-52
VI	DISCUSSION	53-62
VIII	LIMITATIONS	63
VIII	SUMMARY AND CONCLUSIONS	64
IX	BIBLIOGRAPHY	65-71

APPENDICES – I

- PROFORMA
- MASTER CHART

APPENDICES – II

- APPROVAL LETTER OF THESIS PLAN
- THESIS PLAN

LIST OF TABLES

Table No.	Title	Page No.
1	DIFFERENTIATION BETWEEN BENIGN AND MALIGNANT CAUSES OF ILEOCAECAL THICKENING	6
2	AGE DISTRIBUTION OF PATIENTS	25
3	GENDER DISTRIBUTION OF PATIENTS	26
4	CLINICAL PRESENTATION OF PATIENTS	27
5	INTESTINAL INVOLVEMENT	28
6	LENGTH OF INVOLVEMENT	29
7	REGION INVOLVED	30
8	DEGREE OF THICKENING	31
9	BOWEL WALL THICKENING	32
10	PATTERN OF ENHANCEMENT	33
11a	LYMPH NODE INVOLVEMENT	34
11b	LYMPH NODE SIZE	35
12	MESENTERIC FAT STRANDING	37
13	ABSCESS AND SINUS TRACTS	38
14	FAT PROLIFERATION	39
15	SOLID ORGAN ABNORMALITIES	40
16	PERITONEAL THICKENING	41
17	ASCITES	42
18	OMENTAL DISEASE	43
19	CECT DIAGNOSIS	44
20	COLONOSCOPIC FINDINGS	45
21	CORRELATION OF CT FINDINGS WITH FINAL DIAGNOSIS	47
22	CECT FINDINGS OF TB VS IBD	50
23	CORRELATION OF CT DIAGNOSIS OF BENIGN VS MALIGNANT WITH THE FINAL DIAGNOSIS	51

24	**SENSITIVITY AND SPECIFICITY OF CECT IN BENIGN CASES**	**52**
25	**SENSITIVITY AND SPECIFICITY OF CECT IN MALIGNANT CASES**	**52**

LIST OF FIGURES

Figure No.	Title	Page No.
1	AGE DISTRIBUTION OF PATIENTS	25
2	GENDER DISTRIBUTION OF PATIENTS	26
3	CLINICAL PRESENTATION OF PATIENTS	27
4	INTESTINAL INVOLVEMENT	28
5	LENGTH OF INVOLVEMENT	29
6	REGION INVOLVED	30
7	DEGREE OF THICKENING	31
8	BOWEL WALL THICKENING	32
9	PATTERN OF ENHANCEMENT	33
10a	LYMPH NODE INVOLVEMENT	35
10b	LYMPH NODE SIZE	36
11	MESENTERIC FAT STRANDING	37
12	ABSCESS AND SINUS TRACTS	38
13	FAT PROLIFERATION	39
14	SOLID ORGAN ABNORMALITIES	40
15	PERITONEAL THICKENING	41
16	ASCITES	42
17	OMENTAL DISEASE	43
18	CECT DIAGNOSIS	44
19	COLONOSCOPIC FINDINGS	45

LIST OF PICTURES

Picture No.	Title
1	47-YEAR-OLD MALE WITH HISTORY OF CONSTIPATION. (A) AND (B) AXIAL AND CORONAL CONTRAST-ENHANCED CT IMAGES WHICH SHOW CIRCUMFERENTIAL ASYMMETRICAL WALL THICKENING OF CAECUM AND PROXIMAL ASCENDING COLON. (C) AXIAL CECT IMAGE SHOWS OMENTAL STRANDING (BLUE ARROW) AND THICKENING OF PARIETAL PERITONEUM (ORANGE ARROW).(D) AXIAL IMAGE SHOWS NECROTIC CONGLOMERATED LYMPH NODES AT ROOT OF MESENTERY. THE OVERALL FINDINGS FAVORED THE DIAGNOSIS OF ILEOCAECAL TUBERCULOSIS AND WAS PROVEN HISTOPATHOLOGICALLY.
2	A 63-YEAR-OLD FEMALE WITH HISTORY OF PAIN ABDOMEN AND WEIGHT LOSS.(A)AND (B) CORONAL AND AXIAL CECT IMAGES SHOW LONG SEGMENT CIRCUMFERENTIAL WALL THICKENING OF TERMINAL ILEUM, IC JUNCTION AND CAECUM WITH MUCOSAL HYPERENHANCEMENT AND MURAL STRATIFICATION. A SMALL AIR CONTAINING COLLECTION IS SEEN ADJACENT TO TERMINAL ILEUM NEAR IC JUNCTION-SECONDARY TO MICROPERFORATION / SINUS TRACT.(C) AXIAL CECT IMAGE SHOWS ADJACENT FAT STRANDING AND THICK WALLED APPENDIX 74(SECONDARY APPENDICITIS) (D75) CORONAL CECT IMAGE SHOWS SKIP SEG76MENT SHOWING WALL THICKENING AND MURAL HYPERENHANCEMENT SEEN IN TERMINAL ILEUM. OVERALL FINDINGS WERE SUGGESTIVE OF CROHN'S

	DISEASE WHICH WAS CONFIRMED ON HISTOPATHOLOGY
3	**38 YEAR OLD FEMALE WITH HISTORY OF ANEMIA AND WEIGHT LOSS. (A) AND (B) AXIAL AND CORONAL CECT IMAGES SHOW DIFFUSE CIRCUMFERENTIAL HOMOGENOUSLY ENHANCING WALL THICKENING INVOLVING TERMINAL ILEUM AND IC JUNCTION CAUSING DISTENSION OF AFFECTED LOOP AND MARKED LUMINAL NARROWING. (C) AXIAL CECT IMAGE SHOWS MULTIPLE HYPODENSE LIVER LESIONS. (D) CORONAL CECT IMAGE SHOWS SPLENOMEGALY. OVERALL FINDINGS FAVORED LYMPHOMA WHICH WAS CONFIRMED ON HISTOPATHOLOGY**
4	**52-YEAR-OLD MALE WITH HISTORY OF PAIN ABDOMEN.(A) AND (B) CORONAL AND SAGITTAL CECT IMAGES SHOW SHORT SEGMENT OF CIRCUMFERENTIAL WALL THICKENING WITH MURAL HYPERENHANCEMENT INVOLVING DISTAL ILEAL LOOP (ORANGE ARROW). THERE IS FOCAL DILATATION OF TERMINAL ILEUM WITH ENTEROLITH FORMATION (BLUE ARROW). THERE IS A TIGHT STRICTURE AT THE JUNCTION OF CAECUM AND ASCENDING COLON (YELLOW ARROW). (C) AND (D) AXIAL CECT IMAGES SHOW CIRCUMFERENTIAL WALL THICKENING OF DISTAL ILEAL LOOP WITH PROXIMAL DILATATION OF ILEAL LOOPS. OVERALL FINDINGS FAVORED ILEOCAECAL TUBERCULOSIS WHICH WAS CONFIRMED HISTOPATHOLOGICALLY**
5	**52-YEAR-OLD FEMALE WITH HISTORY OF FEVER AND PAIN ABDOMEN. (A), (B) AND (C) AXIAL, CORONAL AND SAGITTAL CECT IMAGES SHOW CIRCUMFERENTIAL MASS LIKE WALL THICKENING OF CAECUM. DISTAL**

	ILEAL LOOPS AND RECTOSIGMOID COLON ARE CLOSELY ADHERENT TO THE MASS. THE MASS IS ABUTTING PELVIC PERITONEUM AND RIGHT ADNEXA. MULTIPLE SUBCENTIMETRIC NECROTIC LYMPH NODES ARE SEEN IN ILEOCOLIC MESENTERY (BLUE ARROW). DIAGNOSTIC POSSIBILITIES INCLUDED MALIGNANCY AND AMOEBIC COLITIS. HISTOPATHOLOGY WAS SUGGESTIVE OF MUCINOUS ADENOCARCINOMA OF CAECUM
6	**47 YEAR OLD MALE WITH HISTORY OF OBSTIPATION. (A) AND (B) CORONAL AND AXIAL CECT IMAGES SHOW CIRCUMFERENTIAL ASYMMETRICAL WALL THICKENING OF DISTAL ILEUM, IC JUNCTION AND CAECUM. (C) AXIAL CECT IMAGE SHOWS NECROTIC LYMPH NODES IN ILEOCAECAL MESENTERY. (D) AXIAL CECT IMAGE SHOWS PROXIMAL DILATED SMALL GUT LOOPS. OVERALL FINDINGS FAVORED ILEOCAECAL TUBERCULOSIS. HOWEVER, HISTOPATHOLOGY WAS SUGGESTIVE OF SIGNET RING CELL CARCINOMA OF COLON**
7	**65-YEAR-OLD MALE WITH HISTORY OF PAIN ABDOMEN. (A) CORONAL CECT IMAGE SHOWS A SHORT SEGMENT OF CIRCUMFERENTIAL WALL THICKENING WITH MURAL HYPERENHANCEMENT INVOLVING DISTAL ILEAL LOOP. (B) SAGITTAL CECT IMAGE SHOWS FOCAL PROMINENCE OF PROXIMAL ILEAL LOOPS. (C) AXIAL IMAGE SHOWS DIRECT NODULAR EXTENSION TO ADJACENT SMALL BOWEL MESENTERY. (D) AXIAL IMAGE SHOWS FEW SUBCENTIMETRIC LYMPH NODES IN ILEOCOLIC MESENTERY. OVERALL IMAGING FINDINGS FAVORED MALIGNANT ETIOLOGY. HISTOPATHOLOGY WAS SUGGESTIVE OF NEUROENDOCRINE TUMOR**

8	**65-YEAR-OLD MALE WITH HISTORY OF CHRONIC DIARRHOEA. (A) CORONAL CECT IMAGE SHOWS ASYMMETRICAL WALL THICKENING WITH MURAL HYPERENHANCEMENT INVOLVING DISTAL ILEAL LOOPS WITH SHORTENING OF MESENTERIC BORDER AND SURROUNDING FIBROFATTY PROLIFERATION. (B) AXIAL CECT IMAGE SHOWS PROMINENT VASA RECTA IN SURROUNDING MESENTERY. OVERALL FINDINGS FAVORED CROHN'S DISEASE WHICH WAS CONFIRMED ON HISTOPATHOLOGY**

BABA FARID UNIVERSITY OF HEALTH SCIENCES
Sadiq Road, Faridkot-151203 (Pb.) INDIA
Phone No. 91-1639-256253 and Fax No. 91-1639-256234
Website: www.bfuhs.ac.in, Email: bfuhspc@gmail.com
(BFUHS - UNIVERSITY LIBRARY- Coordinator APC)

11-BFUHS (LI-PC-134)24/791 Dated: July 11, 2024

Plagiarism Verification Certificate

Title of the thesis: **Role Of MDCT Abdomen In Evaluation Of Ileocaecal Pathologies**

Total Page: 75 (Seventy-Five only) eFSPC (eFile Sent for Plagiarism Check)

Researcher: **Sanchi Baghla**

Supervisor: **Dr. Kamini Gupta**

Research Centre: **Dayanand Medical College and Hospital, Ludhiana**

This is to report that the above thesis was scanned for similarity detection. Process and outcome is given below:

DID:	**2097081**	Software used:	**DRILLBIT**
Date:	**July 11, 2024**	Similarity Index:	**9% (Below 10 Percent)**

Total words count: **13130 (eFSPC)**

The complete report is submitted for review by the Supervisor and Co-Supervisor.

University Coordinator/
Name & Signature (Checked by)
(From University library)

The complete report of the above thesis has been reviewed by the undersigned. (Check Box)

- ☐ The similarity index is below accepted norms.
- ☐ The similarity index is above accepted norms, because of the following reasons:

1.....
2.....
3…….....
4…….....
5……

The thesis may be considered for the award of degree. (Relevant documents attached).

Research Scholar **Supervisor**

INTRODUCTION

The ileocaecal region comprises of caecum, appendix, ileocaecal valve and terminal ileum. [1] These structures may be contiguously involved in disease process as they are closely placed. The ileocaecal region can be involved by general or systemic diseases. It is the most common area of gastrointestinal tract to be involved by pathological processes due to physiological stasis, decreased digestive function, increased absorptive area and abundant lymphoid tissue. [2, 3]

The ileocaecal area can be involved in malignant or benign tumors, infections, inflammatory conditions, ischemia etc. In some cases ileocaecal thickening may be seen without any underlying cause. A normal Ileocolonoscopy has been found in 18%-33% of cases with abnormal bowel wall thickening on MDCT. [4-7] Hence, not all cases of ileocaecal thickening have a pathological cause. It may be caused by non-specific ileitis.

TB is the most common cause of ileocaecal thickening in tropical countries. [4] Crohn's disease is more prominent in North America and Europe. However, its incidence in Asian countries is seen to increase in recent years.[8-9] Ileocaecal region is the most common location for intestinal tuberculosis and Crohn's disease.[8,10-12] Cytomegalovirus, enteric bacterial infections, fungal infections (mucormycosis, aspergillosis, histoplasmosis etc.), ischemic necrosis of caecum, and lymphoma should be considered in immunocompromised and post-transplant patients apart from tuberculosis.[13] In the elderly population, malignancy in the ileocaecal region is an important cause of ileocaecal thickening.[14-15]

Clinical evaluation

Imaging findings are often non-specific; hence clinical correlation is often required to arrive at the final diagnosis. Right lower quadrant abdominal pain is the most common clinical manifestation.[4] Onset and duration of

symptoms and presence of features such as anorexia, diarrhoea, fever, weight loss, contact history of tuberculosis, immunocompromised status, etc. help in narrowing the differential diagnosis.

In patients presenting with abdominal pain, fever, diarrhoea, hematochezia, weight loss and intestinal obstruction, ileocaecal tuberculosis and Crohn's disease remain an important diagnostic consideration.[16] Lung involvement, abdominal lump, fever, ascites and night sweats are more commonly seen in ileocaecal tuberculosis, however, extraintestinal manifestations such as diarrhoea, perianal disease and hematochezia are more common in Crohn's disease.[16] Contact history with a TB patient and coexisting pulmonary TB point more towards ileocaecal TB. [12]

The duration of symptoms is longer in Crohn's disease as compared to ileocaecal TB. [12]

In an elderly patient, right lower quadrant mass with weight loss, anorexia and symptoms of anaemia should warrant the diagnostic possibility of malignancy. Adenocarcinoma is the most common malignancy associated with these symptoms. Left-sided colon cancer can present with intestinal obstruction but caecal carcinoma can act as a lead point for intussusception. [14,17] A Family history of carcinoma colon and a long history of IBD can point to an underlying colon cancer.[18] Most common sites of involvement of primary gastrointestinal lymphoma are ileum and caecum accounting for approximately 18- 26% of cases.[19-20]

Radiological evaluation

Imaging the small bowel is often a challenging task due to its length, tortuosity, and undulating nature. However, advancements in technology have improved the imaging process. Ideal small bowel imaging should provide comprehensive information about the lumen, mucosa, wall, extra-enteric involvement, and the extent as well as severity of any disease. Choice of imaging modality is influenced by factors such as invasiveness,

use of ionizing radiation or intravenous contrast, cost, and accessibility. Traditional small bowel follow-through examinations are becoming less common and are being replaced by cross-sectional imaging techniques.

Fluoroscopic studies, such as barium meal follow-through, ensure luminal distension, making them ideal for visualization of enteric mucosa and partial strictures. However, the sensitivity of these tests can be reduced by overlapping bowel. While capsule endoscopy offers superior mucosal visualization and the ability to obtain biopsies for histological assessment, it has limitations, including inability to view extra-enteric structures, subjective interpretation, difficulty in tumor localization, and the risk of lodging in patients with strictures. CT and MR enteroclysis also rely on luminal distension with enteric contrast material administered through a nasoenteric tube, followed by spatial and temporal imaging of the bowel. These modalities are excellent for detecting strictures, but their semi-invasive nature, which can cause patient discomfort, and the need for expert operation, often limit their widespread use.

Role of Multi detector Computed Tomography (MDCT)

Multidetector computed tomography has become an important tool in characterization of bowel abnormalities and allows assessment of mural and extraluminal abnormalities. [21, 22]

Thickening of bowel wall is a frequent finding in patients with gastrointestinal symptoms and suggests possible bowel disease. The normal thickness of small bowel wall on CT varies depending on bowel distension. Wall thickness in a well-distended gut loop measures upto 3 mm and can be up to 5 mm when the lumen is collapsed. [23-25]

The various causes of bowel wall thickening include neoplastic, infectious, inflammatory, ischemic conditions or it can be nonspecific or secondary to systemic reasons. In some cases, mural thickening may be due to technical reasons like inadequate bowel distension. CT diagnosis in a bowel pathology depends upon length of the involved segment, degree of

thickening, symmetrical vs asymmetrical involvement, pattern of attenuation and enhancement, peri-intestinal abnormalities like lymphadenopathy, abscess and sinus tracts, mesenteric fat stranding, fat proliferation and associated solid organ abnormalities.[21-26]

Focal, segmental or diffuse bowel wall thickening

When thickening of small or large bowel wall is identified on CT, the first step is to assess the extent of bowel involvement. A distinction should be made between focal (less than 5 cm), segmental (6-40 cm) or diffuse (>40 cm) involvement. This is an important step in differentiating between benign and malignant causes of bowel wall thickening. [27, 7] Symmetrical and mild thickening (less than 2 cm) is commonly seen in inflammatory, ischemic and infectious causes whereas asymmetrical and marked thickening (more than 2 cm) is seen in malignant conditions. In some cases, infectious and ischemic processes may present with marked bowel wall thickening. [21] Focal thickening is usually seen in diverticulitis, adenocarcinoma and appendicitis (less than 10 cm long). Segmental thickening (up to 30 cm) is usually present in Crohn's disease, lymphoma, ischemic causes and infectious ileocolitis whereas diffuse thickening is commonly seen in vasculitis, eosinophilic enteritis, infiltrative disorders and infectious ileocolitis.

The enhancement pattern of bowel wall is also an important factor which helps in narrowing the diagnostic possibilities. Homogeneous attenuation is seen in small adenocarcinoma, lymphoma, localized infarction, submucosal haemorrhage, Crohn's disease and chronic radiation enteritis. [28, 29-31] Heterogeneous and stratified enhancement is seen in ischemic, infectious and inflammatory causes. Stratified enhancement pattern usually excludes malignancy.[28,32,33] Large adenocarcinoma and gastrointestinal stromal tumours can have heterogeneous mixed attenuation pattern.

Symmetrical versus asymmetrical thickening

Symmetrical thickening of the bowel wall is observed in intestinal inflammatory conditions, infections, bowel edema, and ischemia.[32] Additionally, submucosal hemorrhage can also cause symmetrical thickening of the bowel wall.[29, 34] Neoplasms like scirrhous carcinoma and lymphoma may present with this type of thickening as well.[30.32] Conversely, asymmetrical or eccentric bowel wall thickening is typically associated with malignant conditions such as stromal tumors, adenocarcinoma, carcinoid tumors, metastasis, and occasionally lymphoma. However, an exception is long-standing Crohn's disease, which can manifest with asymmetrical thickening. Irregular, short, asymmetric thickening with abrupt margins is particularly indicative of adenocarcinoma and metastatic disease. [35]

Associated abnormalities

A major advantage of MDCT over barium studies or endoscopy is its ability to show extra intestinal manifestations such as lymph nodes, mesenteric stranding, calcification, sinus tracts and fistulae, abscess, fat proliferation, vascular occlusion and solid organ abnormalities.

The predominant causes of ileocaecal thickening include inflammatory and malignant causes hence it is important to differentiate between them. The table shows the differentiation between benign and malignant causes.

Table 1: Differentiation between benign and malignant causes of Ileocaecal thickening

	Malignant etiology	Inflammatory etiology
Pattern of IC thickening	asymmetric, irregular	regular, symmetrical
Length of involvement	short segment	Long segment (exception - lymphoma)
Wall thickness	more than 3 cm	less than 2 cm
Attenuation pattern	homogeneous or mixed attenuation	stratified attenuation
Lymphadenopathy	adjacent lymph nodes, necrotic, large	adjacent lymph nodes maybe present, usually homogeneous (exception tuberculosis)
Perienteric fat stranding	usually absent	could be present
Transition of thickening	abrupt transition from abnormal to normal	gradual transition from abnormal to normal

Ileocaecal tuberculosis and Crohn's disease form the majority of causes of ileocaecal thickening hence it is important to differentiate between the two.

Both present with symmetrical thickening of the ileocaecal region. Multiple and long segment eccentric strictures with mural stratification, perianal fistulae, interbowel fistulae, increased mesenteric vascularity and fibrofatty proliferation are more in favor of Crohn's disease. The presence of ascites, abdominal cocoon formation, omental involvement, bulky abdominal lymphadenopathy and enteroliths suggest the possibility of TB over IBD. [36-38]

Adenocarcinomas present with short segment marked thickening of caecum without a stratified pattern of fat stranding. [31] Carcinoid tumors of ileum and appendix may also present with ileocaecal thickening. Hypervascular wall thickening or a hyperattenuating submucosal mass with calcification is a usual presenting feature of carcinoid tumour. [39] Lymphoma presents as marked, symmetrical, circumferential bowel wall thickening with poor enhancement and homogeneous attenuation. Ulceration and cavitation may be seen in cases of lymphoma. [30] GIST of the ileocaecal region presents as a well-circumscribed exophytic mass.[40] Ischemic bowel shows circumferential wall thickening and a target sign in few cases. Thickened wall may show reduced or no enhancement in cases of mesenteric ischaemia.[29] Lipoma of the ileocaecal area presents as an asymmetric mass.[41,42]

Laboratory evaluation

Lab investigations help in narrowing the differential diagnosis. Anemia can be seen in Crohn's disease, tuberculosis, malignancy, lymphoma, etc. Leukocytosis may be seen in infectious ileocolitis. C reactive protein is elevated in TB, Crohn's disease and inflammatory conditions.[43] Mantoux test and Interferon Gamma Release assay help in the diagnosis of tuberculosis. CEA is a tumor marker for colon carcinoma. Stool examination is a low cost tool which can help in diagnosis of infectious causes such as amoebiasis and salmonellosis.

Endoscopy

Ileocolonoscopy and histopathological investigations help to reach a definitive diagnosis. Longitudinal ulcers, aphthous ulcers, skip lesions, cobblestone appearance, multisegment involvement and perianal fistulae are more commonly seen in Crohn's disease. Transverse ulcers with patulous ileocaecal valve and contiguous involvement of ileum and caecum are more commonly seen in TB.[12,16] Infective diseases may also present with ulcers in the ileocaecal region and lower gastrointestinal bleeding. Carcinoma colon presents as a polypoidal or ulceroproliferative mass. Lymphoma can have a heterogeneous appearance on endoscopy and may represent as annular or exophytic tumour, ulcer or multiple polyps. [44]

Histology

Histology is the Gold standard for diagnosis. Large, confluent, multiple granulomas with lymphocyte cuffing and submucosal location favor ileocaecal TB. Caseation necrosis is pathognomic of tuberculosis. Crypt centered inflammation such as pericryptal granulomas and focally enhanced colitis suggest Crohn's disease.[45] Carcinoma colon is characterized by medium to large sized abnormal glands with moderate desmoplastic stroma. Inspissated eosinophilic mucus and cellular debris fill the glandular lumina resulting in dirty necrosis.[46] Diffuse large B cell lymphoma shows diffuse infiltration of medium to large lymphoid cells with oval to round vesicular nuclei and 2-4 nucleoli. Amoebic colitis presents with glass shaped abscess with undermining of normal mucosa and necro inflammatory exudates with organisms showing foamy cytoplasm and round and eccentric nucleus with erythrophagocytosis.Hence, a systemic approach with the integration of clinical, biochemical, radiological, endoscopic and histological tests is the key to reaching or definite diagnosis in cases of IC thickening.

AIMS AND OBJECTIVES

1. To characterize the ileocaecal pathologies on MDCT abdomen
2. To correlate MDCT findings with clinical, endoscopy findings and histopathology wherever possible.

REVIEW OF LITERATURE

Lundstedt C et al (1996) conducted study on 503 patients with a clinical suspicion of malignancy, and found to have culture or biopsy proven TB were reviewed in order to evaluate the spectrum of TB manifestations in this group of patients. Abdominal manifestations were found in 112 patients; in 1/3rd abdominal disease was the only evidence of tuberculosis. Pulmonary TB was found in half of the patients. The most common abdominal TB manifestations of peritonitis and lymph node enlargement, each occurring in about 1/3rd of the patients. 1/3rd of the patients had genitourinary TB manifestations. About 1/5th had TB of the liver, spleen or pancreas or in the gastrointestinal tract, respectively. Multiple organ involvement was common. [47]

Bodily KD et al (2006) did a study to correlate endoscopic and histopathological findings of inflammatory CD with CECT. Biopsy in the terminal ileum demonstrated an equivalent sensitivity for demonstration of active inflammation at the terminal ileum for CTE and ileoscopy (81% vs 81%) but the specificity of CTE was significantly lower than that of ileoscopy (70% vs 97%).[48]

Wolff et al (2007) did a study on 107 cases to determine the utility of colonoscopy in managing patients with abdominal pain who were found to have colonic thickening on computed tomography. Out of these, 8 had colorectal adenocarcinoma. Inflammatory bowel disease was seen in 10 of these patients. 16 had findings consistent with infectious colitis and 39 had ischaemic colitis. 6 patients had miscellaneous findings responsible for colonic thickening (appendicitis, diverticulitis, proctitis and melanosis coli). No abnormality was found in 28 of these patients. In patients diagnosed with colorectal carcinoma or inflammatory bowel disease, 4 out of 18 patients presented with gastrointestinal bleeding. On the basis of a new diagnosis of colorectal carcinoma and inflammatory bowel disease, it was recommended that colonoscopy should be performed after clinical

evaluation in patients with abdominal pain and colonic thickening on computed tomography. [49]

Amarapurkar et al (2007) did a prospective study in India in patients over 3 years with a definitive diagnosis of CD and an equal number of patients with diagnosis of gastrointestinal TB. The study was conducted on 26 patients with gastrointestinal TB and 26 patients with CD. In Univariate analysis, the following clinical variables between both groups were significant: Duration of symptoms (58.1 +/- 9.8 vs 7.2 +/- 3.4 months), bleeding per rectum (30.7% vs 3.8%), diarrhoea (69.2% vs 34.6%), ascites (7.7% vs 34.6%) and extra intestinal manifestations of IBD (61.5% vs 23.1%). Based on fever, bleeding per rectum, duration of symptoms and diarrhoea, the accuracy of predicted CD was 84.62% while it was 63.4% when histopathology was reported as inflammatory bowel disease and approximately 42.3% when there was a recurrence of disease after surgery. In the case of coexisting pulmonary lesions and/or abdominal lymphadenopathy, the accuracy of predicting gastrointestinal TB was 73.1%, 75% when histologically reported, 63.4% when granuloma was found on histology, 82.6% when there was a positive TB PCR and 61.5% when there was AFB positive smear and/or culture. Serological test was not useful for differentiation of gastrointestinal tuberculosis from Crohn's disease. It was concluded that parameters like diarrhoea, duration of symptoms, fever, and bleeding per rectum have a high accuracy in differentiating gastrointestinal TB from CD. [11]

Scott E et al (2007) conducted a study on 700 patients with suspected small bowel disease. He found the sensitivity of CTE for active inflammatory CD to be over 85% when compared with fluoroscopic enteroclysis and barium follow-through examinations. The sensitivity of CTE was 77% for active inflammation when using endoscopic findings or surgical findings as a reference. [50]

Makharia et al (2009) conducted a study to find out clinical, endoscopic and histological features for differentiation between CD and intestinal TB. 106 patients were recruited, 53 each with intestinal tuberculosis and Crohn's disease. On Univariate Analysis, partial intestinal obstruction, constipation, nodular lesions, and granulomas were more common in intestinal tuberculosis, whereas longer duration of disease, diarrhoea, blood in stools, extraintestinal manifestations, perianal disease, left colonic involvement, aphthous ulcers, skip lesions, cobble stoning, longitudinal ulcers, microgranulomas, focally enhanced colitis were significantly more common in Crohn's disease. On Multivariate Analysis, blood in stools, weight loss, involvement of the sigmoid colon, and histologically focally enhanced colitis were independent predictors of intestinal TB. On the basis of regression coefficients of multivariate logistic model, a score that varied from 0.3 to 9.3 was devised. There was an increased likelihood of intestinal tuberculosis in the case of higher score. It was concluded that the most important features helpful in differentiating between CD and Intestinal TB were blood in stools, weight loss, focally enhanced colitis and involvement of sigmoid colon. [12]

Uzzaman et al (2011) did a retrospective analysis of abdominopelvic computed tomography, identifying bowel wall thickening in patients and correlating the reports with subsequent endoscopic evaluation. The study was conducted on 165 patients out of which abnormalities on endoscopy at that site of bowel wall thickening were found in 95 patients and malignancy was detected in 36 cases. Bowel Wall thickening of the transverse colon was more likely to correspond to the endoscope findings of cancer as compared to the other sites. As compared with normal endoscopy, rectal bleeding was significantly more in patients of bowel wall thickening and malignancy. 59.2% of Caucasians showed neoplastic lesion at the site of bowel wall thickening, much higher than the other groups. Out of 38 patients who had no bowel symptoms, 6 were diagnosed with colorectal cancer. It was concluded that endoscopic

evaluation should be done in investigating patients with CT evidence of bowel wall thickening, especially in cases of thickening of transverse colon, in patients with symptoms of rectal bleeding and in Caucasians. [27]

In 2011, Troppmann et al conducted a retrospective study to assess bowel wall thickening observed in CT scans. The study included 62 patients with bowel wall thickening. Of these, 21% had generalized thickening, while 58% had thickening confined to one segment of the colon, predominantly on the left side. Endoscopy was performed on 44% of the patients. Histological confirmation of malignancy was found in 2 patients, 19% had normal endoscopy results, and 67% showed benign findings. The study concluded that bowel wall thickening is not a common finding on CT scans. Endoscopic evaluation was conducted in less than half of the patients, revealing pathological findings in 80% of those cases. Therefore, it was recommended that endoscopic evaluation should be performed when bowel wall thickening is reported on a CT scan. [51]

In 2012, Finkelstone et al conducted a retrospective study over one year, focusing on patients with small bowel wall thickening observed in CT scans of the abdomen and pelvis. The study identified the causes of bowel wall thickening as follows: primary inflammation in 62 out of 446 cases (13.90%), reactive inflammation in 69 cases (15.47%), iatrogenic factors in 33 cases (7.40%), neoplastic causes in 32 cases (7.17%), ascites in 30 cases (6.73%), unknown causes in 28 cases (6.28%), ischemic conditions in 24 cases (5.38%), and miscellaneous causes in 17 cases (3.81%). The study concluded that the most common causes of small bowel thickening were inflammatory and infectious conditions. [26]

Lee et al (2012) did a study to evaluate the clinical significance of large intestine wall thickening on CT. Medical records of 815 patients who had undergone endoscopy after CT scans within 1 month were reviewed retrospectively. 233 patients were included in the study. In 81.1% of cases, wall thickening was associated with abnormal endoscopic findings. The accuracy rate on diagnosis between endoscopy and CT was 63.5%.

CT findings suggestive of malignancy were length of lesion<5 cm and lymph nodal enlargement. It was concluded that endoscopic evaluation is needed in patients with bowel wall thickening in order to exclude malignancy. [52]

Min et al (2013) did a retrospective analysis of Pediatrics Patients presenting with abdominal pain and CT findings of bowel wall thickening. Clinical variables, endoscopic findings, and follow-up assessments were evaluated. 56 patients presenting with abdominal pain and bowel wall thickening were identified. Overall, 30 patients had terminal ileal wall thickening, 17 had colonic wall thickening and 9 and other small bowel thickening. 14 out of 56 patients who underwent endoscopy had positive findings, out of which 11 had histological evidence of chronic colitis and 5 had duodenitis/ileitis. Ultimately, IBD was diagnosed in 11/56 patients, 8/56 had functional abdominal pain/constipation, 10/56 had infectious gastroenteritis, 9/56 had appendicitis and 18/56 with miscellaneous diagnoses. It was concluded that bowel wall thickening on CT scan is a non-specific finding in children. The need to undergo additional evaluation and endoscopy may be determined by laboratory evaluation. [5]

In 2014, Al-Khowaiter et al conducted a study to determine that bowel wall thickening is a frequently reported finding on diagnostic abdominal pelvic CT scans in patients without a history of gastroenterological disease. The study included 76 patients who met the inclusion criteria. Among these patients, 76% had identifiable pathology on colonoscopy, while 24% had normal colonoscopy results. The most common causes of bowel wall thickening were inflammatory bowel disease (IBD) and infectious colitis. Skip lesions observed on CT were associated with IBD. Pancolitis was linked to endoscopic findings of IBD in about 25% of cases, infections in 50% of cases, and normal findings in 25% of cases. Stranding on CT with bowel wall thickening was associated with non-neoplastic endoscopic pathologies, including IBD, ischemia, and infectious colitis, but it was also seen in 26% of cases with normal endoscopic findings. Lymphadenopathy

was reported in 17% of CT scans and was associated with IBD, neoplastic processes, and infectious colitis, but it was also a normal endoscopic finding in 15% of patients. The study concluded that symptomatic patients with non-specific bowel wall thickening on CT should undergo definitive endoscopic investigation, as the majorities are likely to have significant gastroenterological disease. [7]

In 2014, Zhao et al conducted a retrospective study involving 141 patients with Crohn's disease (CD) and 47 patients with intestinal tuberculosis (ITB). The aim was to assess the usefulness of clinical features and CT enterographic manifestations in differentiating between CD and ITB. Parameters were analyzed using logistic regression. Clinical features indicative of CD included hematochezia and perianal disease. For ileocaecal TB, positive purified protein derivative skin test, ascites, pulmonary tuberculosis, and night sweats were indicative. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of the regression model based on clinical features were 94.3%, 80.4%, 91.0%, 93.7%, and 82.6%, respectively. CT enterographic indicators of CD included involvement of the left colon, an asymmetric pattern of involvement, abscess, and the comb sign. Indicators for ileocaecal TB included lymph node distribution along the right colic artery, contracture of the ileocaecal valve, fixed patulous ileocaecal valve, and lymph nodes with central necrosis. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of the regression model based on CT enterographic parameters were 96.5%, 93.6%, 95.7%, 97.8%, and 89.8%, respectively. The study concluded that the high accuracy of the CT enterography model suggests the potential of using CT enterography as an alternative to endoscopy for distinguishing between CD and ileocaecal TB. [36]

In 2015, Kalioubie M conducted a study on 50 patients with chronic diarrhea, including 23 with Crohn's disease, 3 with ulcerative colitis, 5 with tuberculous enteritis, 1 with Entamoeba infestation, 4 with celiac disease,

5 with lymphoma, and 10 with other conditions, all evaluated using CT enterography (CTE). The quantitative image analysis assessed bowel caliber and wall thickness, while the qualitative analysis examined anatomical localization of lesions, effacement of mucosal hyperenhancement, adhesions, fistulae, pattern reversal, lymphadenopathy, and other extra-parietal changes. The accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for Crohn's disease, and sensitivity and PPV were calculated for lymphoma. The study concluded that most Crohn's lesions affected the ileum, ulcerative colitis predominantly affected the colon and involved the terminal ileum, celiac disease primarily affected the jejunum, and lymphoma typically affected the ileum. CTE showed a sensitivity of 100% and a specificity of 0% for these conditions. [53]

Megally H et al (2015) conducted a study on 39 patients and concluded that MDCT is a superior modality to detect small bowel diseases. Confirmation was provided by histopathological investigations.43.5% of patients presented with neoplastic pathology and the rest 56% presented with non-neoplastic entities. [54]

In 2015, Masselli et al conducted a prospective study to compare the accuracy of computed tomographic (CT) enterography and magnetic resonance (MR) enterography in detecting and characterizing small bowel diseases. The study included 150 consecutive patients (81 men and 69 women; mean age, 38.8 years; range, 18–74 years) suspected of having small bowel disease based on clinical findings, with normal previous upper and lower gastrointestinal endoscopy results. All patients underwent both CT and MR enterography. Two independent reviewers analyzed the CT and MR enterographic images to identify small bowel diseases, differentiate between inflammatory and non-inflammatory conditions, and detect extraenteric complications. Overall, the sensitivity, specificity, and accuracy for detecting small bowel lesions were 75.9% (41 out of 54), 94.8% (91 out of 96), and 88.0% (132 out of 150), respectively, for CT

enterography, and 92.6% (50 out of 54), 99.0% (95 out of 96), and 96.7% (145 out of 150), respectively, for MR enterography.MR enterography demonstrated significantly higher sensitivity compared to CT enterography in detecting overall small bowel diseases (P = .0159) and neoplastic diseases (P = .0412). However, there was no significant difference in sensitivity between the two modalities for detecting inflammatory diseases (P > .99) or non-inflammatory/non-neoplastic diseases (P = .6171). [55]

In 2015, Kedia et al studied 54 patients with Crohn's disease (CD) and 50 patients with intestinal tuberculosis (ITB), comparing various clinical and imaging parameters between the two conditions. Univariate analysis revealed significant differences in left colonic involvement, ileocaecal involvement, long-segment involvement, comb sign, presence of skip lesions, involvement of ≥3 segments, and presence of lymph nodes ≥1 cm between CD and ITB. Multivariate analysis identified ileocaecal involvement, long-segment involvement, and presence of lymph nodes ≥1 cm as statistically significant factors. Based on these findings, a risk score ranging from 0 to 3 was developed. Scores of 0 and 1 showed specificity of 100% and 87%, respectively, with positive predictive values (PPV) of 100% and 76%, respectively, for diagnosing ITB. Scores of 2 and 3 had specificity of 68% and 90%, respectively, with PPV of 63% and 80%, respectively, for diagnosing CD. The study concluded that a predictive model based on the presence of long-segment involvement, ileocaecal involvement, and lymph nodes ≥1 cm on CT imaging could effectively differentiate between ITB and CD, demonstrating good specificity and PPV. [56]

Gale et al (2017) included patients who underwent either CT or MR enterography and had endoscopic biopsy within 28 days of imaging. Two pediatric radiologists blinded to the histological results reviewed imaging studies and scored the bowel for the presence or absence of mural features (wall thickening >3 mm, mural hyper enhancement) and perienteric features (mesenteric hypervascularity, edema, fibro fatty

proliferation and lymphadenopathy) of active disease. Mural imaging features had the highest association with active inflammation both for MR enterography (wall thickening had 80% accuracy, 69% sensitivity and 91% specificity; mural hyperenhancement had 78%, 53% and 96%, respectively) and CT enterography (wall thickening had 84% accuracy, 72% sensitivity and 91% specificity; mural hyperenhancement had 76%, 51% and 91% respectively), with perienteric imaging features performing significantly worse on MR enterography relative to CT enterography ($P < 0.001$). They concluded that mural features are predictors of active inflammation for both CT and MR enterography, while perienteric features can be distinguished better on CT enterography compared with MR enterography. [57]

Varma RU et al in 2017 conducted a CT enterography study on 84 patients clinically suspected or known to have small intestinal disease. The radiologic findings were correlated with clinical, endoscopy, histopathology and operative findings. In their study, majority of the patients had non-neoplastic pathologies (79%). Neoplastic lesions were detected in 21% of the patients of which 14% were malignant. There was a good correlation between CT enterography and endoscopy, histopathology and operative findings. They concluded that CT enterography should be considered as the investigation of choice for radiological evaluation of small bowel pathologies as it provides a comprehensive evaluation of the disease process. [58]

Iadicola et al (2018) did a retrospective study on 40 patients complaining of abdominal pain and had undergone abdomen CT scan in which bowel wall abnormalities were found were selected. It was found that 75% of patients had a benign condition and 25% had a malignant condition. In the small bowel group, 33.3% of patients had ischemic disease, 33.3% non-specific pattern, 22.2% had an inflammatory disease and 11.1% were diagnosed with cancer. It was then recommended that endoscopic evaluation should be done in all patients with intestinal wall abnormalities

on CT scan, due to the increasing rate of cancer and IBD. Capsule endoscopy should be taken into account in patients presenting with severe symptoms and after a previous negative endoscopic examination. [6]

A Kumar et al (2018) conducted a prospective study to determine the clinical relevance of ileal and / or caecal thickening on CT. A total of 50 patients were included in the study out of which 39 patients presented with abdominal pain. 46 patients had thickening of terminal ileum, 25 patient had caecal wall thickening and 21 had both caecal and ileal wall thickening. The mean wall thickness of caecum and ileum on computed tomography was 7.23+3.2 mm and 5.5+3.1 mm respectively. Tuberculosis was the final diagnosis in 24 patients (48%), Crohn's disease in 10 (20%), adenocarcinoma in 1 patient. Abnormal colonoscopic findings were demonstrated in 41 patients with ulcerations as the most common. Normal colonoscopy and histopathology were seen in 4 patients out of 15 patients with ileocaecal bowel wall thickening, in the remaining 11 patients, histopathology showed non-specific findings and these patients were asymptomatic on follow-up. Involvement of the caecum with Ileocaecal Junction, ascending colon involvement, peri ileocaecal stranding and long segment stricture was more common in patients with underlying disease as compared to the non-diseased patients. It was concluded that the majority of patients with ileocaecal wall thickening on CT have an underlying disease and should be further evaluated by colonoscopy and biopsy. [4]

Amine et al (2018) conducted a prospective study on 87 patients with GIT symptoms where CTE was performed to evaluate its possible impact on accurate diagnosis, detection of complications and consequent guidance for management planning. The study concluded an undeniable role of MDCT in diagnosing Crohn’s disease and its complications, with a proven efficacy in identifying the enteric and extra-enteric manifestations of the disease. [59]

In 2018, Anshul Chamail et al conducted a study involving 65 patients suspected of having small bowel disorders based on clinical examination. Among these patients, 32 (49%) showed abnormal thickening of the small bowel. Intestinal tuberculosis was the most frequent diagnosis, identified in 11 cases (16.9%). The ileocaecal junction was predominantly involved in 81% of tuberculosis cases, showing homogeneous enhancement in 81% of cases with either focal (46%) or segmental (54%) patterns of involvement. Small bowel tumors were observed in 9 cases, primarily adenocarcinoma (7 cases). Malignant tumors exhibited marked asymmetrical thickening in 81% of cases, focal thickening in 54% of cases, and heterogeneous enhancement in 91% of cases. The study concluded that CT enterography is a highly effective imaging modality for evaluating small bowel disorders, providing detailed insights into conditions such as intestinal tuberculosis and small bowel tumors based on patterns of thickening and enhancement observed. [60]

Misra RN (2019) conducted a study on 30 patients with clinically suspected small bowel disease who underwent CT enterography using iso-osmotic mannitol as neutral enteral contrast. CT enterography diagnoses were compared with clinical, surgical and histopathological results. Adult patients with clinically suspected small bowel disease were included in the study. A patient not consenting to imaging study as protocol, contraindications to contrast enhanced CT i.e. allergy to intravenous iodinated contrast media, pregnancy, hemodynamic instability, renal failure, inability for sufficient breath hold, acute high-grade intestinal obstruction/perforation and acute intestinal infections are excluded. They included 30 adults presenting with clinically suspected small bowel disease. They comprised of 14 male and 16 female patients of age ranging from 16-70 years with a mean age of 31.03years. Most patients belonged to the 21-30 years age group. CT enterography showed a sensitivity (95.83%), specificity (100%), positive predictive value (100%), negative predictive value (85.71%), and accuracy (96.66%) in the

diagnosis of small bowel diseases. They concluded that CTE is a non-invasive, well tolerated and reliable imaging modality for the depiction of small-bowel diseases and it provided excellent visualization of luminal, mural and extraintestinal findings. [61]

MATERIALS AND METHODS

SOURCE OF DATA

This study was conducted over a period of one and a half year and included patients referred for MDCT abdomen to the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana and found to have ileocaecal pathologies

METHOD OF COLLECTION OF DATA

This study was conducted over a period of one and a half year starting from 15 Sept 2022 to 15 March 2024 and included patients referred for MDCT abdomen to the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana and found to have ileocaecal pathologies Informed consent was obtained from all the subjects /guardians before the study. The clinical history regarding the onset of symptoms and examination findings was recorded as per performa. MDCT of the patients was performed on Siemens 128 slice CT scan machine after giving intravenous omnipaque contrast and peglac.

PREPARATION OF PATIENT

The procedure was explained to the patient in his/her vernacular language to alleviate fear and anxiety. During the entire period of the procedure patient was in contact with the technician/doctor through a two-way intercom system

MDCT PROTOCOL

MDCT Protocol for the image acquisition was as follows:

The Scan was performed with the patient in supine position in quiet respiration. I.V contrast study using non-ionic water-soluble contrast medium was done following plain study.

- Scan duration: 90 seconds with a scanning delay time of 30 seconds for arterial phase and 60 seconds for venous phase.
- Scan area of interest: dome of diaphragm to pubic symphysis
- Direction of scan: cranio-caudal
- Collimation: 128*0.6 mm
- Pitch: 0.8 • Reconstructed Slice thickness: 1mm
- Amount of contrast given and injection rate: 1.5ml/kg body weight at the rate of 3 ml/sec
- FOV(field of view): 400-750 mm
- Current : 175Mas
- Voltage: 120 kV

Inclusion Criterion-

Patients with ileal and/ or caecal wall thickening on Multidetector Computed Tomography (MDCT) abdomen

Exclusion Criterion-

Biopsy proven cases of ileocaecal disease

DURATION OF STUDY- one and a half year

MDCT images interpretation:

1. Length of intestinal involvement-focal (less than 5 cm), segmental (6-40 cm) or diffuse (>40 cm) involvement
2. Bowel wall thickening- Symmetrical vs Asymmetrical
3. Degree of wall thickening- mild to moderate(<1 cm) and marked(>1 cm)
4. Pattern of enhancement- Homogenous, stratified and heterogenous
5. Lymph node involvement-Homogenously enhancing, necrotic or calcified Lymph nodes
6. Ileocaecal valve- normal, contracted or patulous

7. Ileocaecal angle-normal, obtuse or right angle
8. Mesenteric fat stranding
9. Abscess and sinus tracts
10. Fat proliferation
11. Solid organ abnormalities
12. Ascites
13. Peritoneal thickening- Smooth or irregular/ nodular
14. Omental disease

STATISTICAL ANALYSIS

Data was described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. For comparing categorical data, Chi-square ($\chi 2$) test was performed and Fisher exact test was used when the expected frequency is less than 5. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were also calculated. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

OBSERVATIONS AND RESULTS

1. DEMOGRAPHIC DATA

30 patients were evaluated in the current study conducted between the period of 15 September 2022 to 15 March 2024. The age range of patients was from 9 -74 years with a mean age of 45.30 +/- 15.93 (Table 2, Figure 1), including 14 females and 16 males as shown in (Table 3, Figure 2).

Table 2: Age distribution of patients

Age group	No. of cases	Percentage
< 20	2	6.7%
21-30	4	13.3%
31-40	4	13.3%
41-50	11	36.7%
51-60	3	10.0%
> 60	6	20.0%
Total	30	100.0%

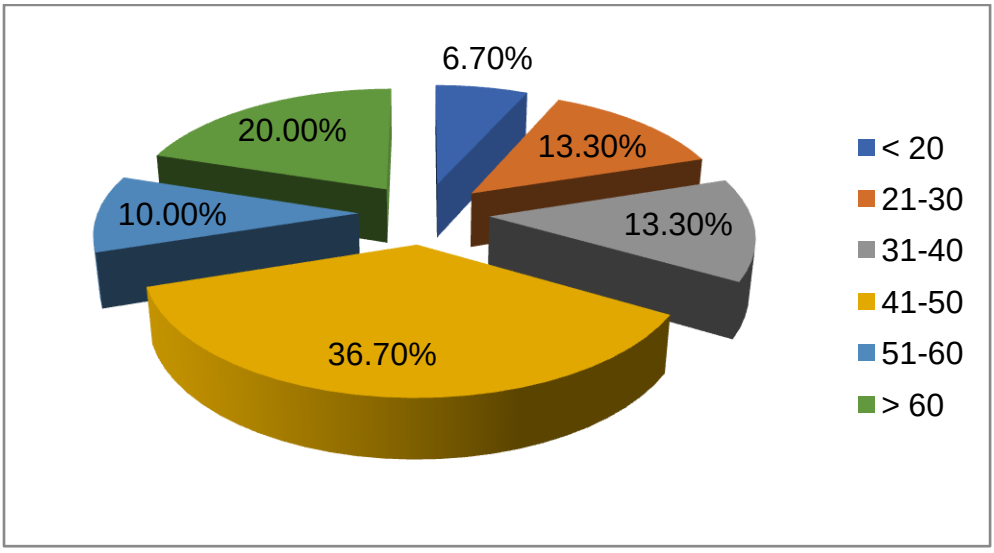


Figure 1: Age distribution of patients

Table 3: Gender distribution of patients

SEX	No. of cases	Percentage
F	14	46.7%
M	16	53.3%
Total	30	100.0%

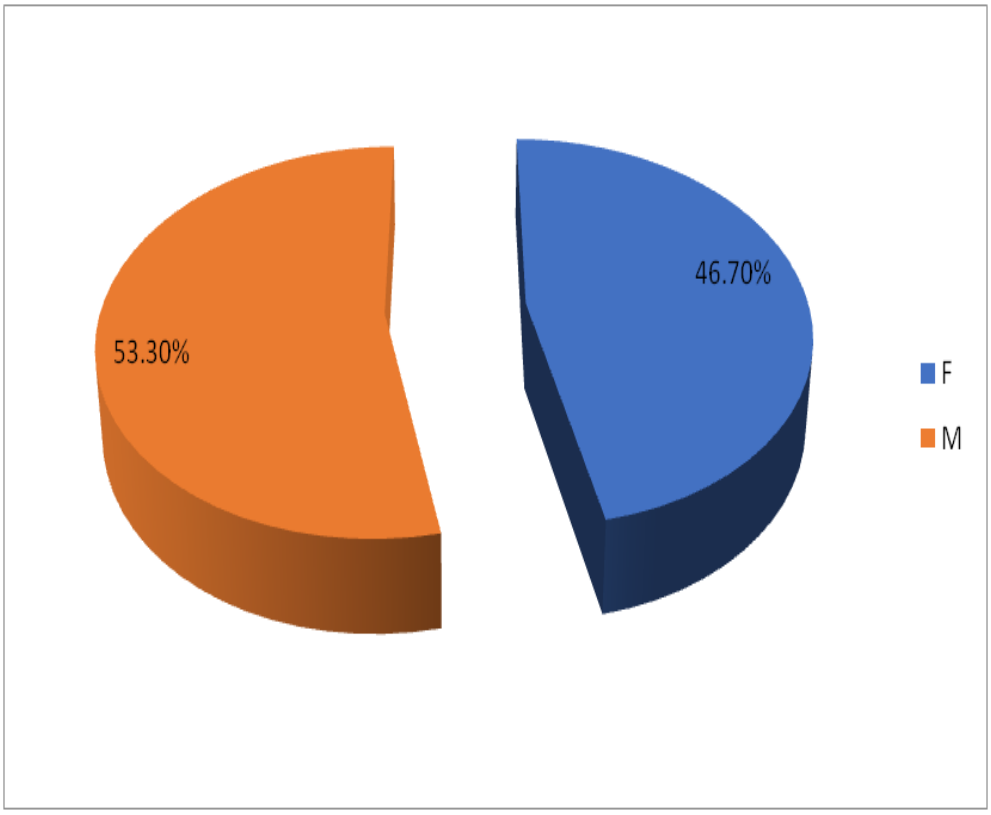


Figure 2: Gender distribution of patients

2. CHIEF COMPLAINTS

Out of 30 patients, 28 (93.3%) patients presented with pain abdomen, 15 (50%) patients presented with altered bowel habits, 9 (30%) patients presented with loss of weight/appetite, 7 (23.3%) patients presented with fever and only 5 (16.7%) patients presented with vomiting (Table 4, Figure 3)

Table 4: Clinical presentation of patients

CHIEF COMPLAINTS	No. of cases	Percentage
FEVER	7	23.3%
PAIN ABDOMEN	28	93.3%
VOMITING	5	16.7%
ALTERED BOWEL HABITS	15	50.0%
LOSS OF WT/ APPETITE	9	30.0%

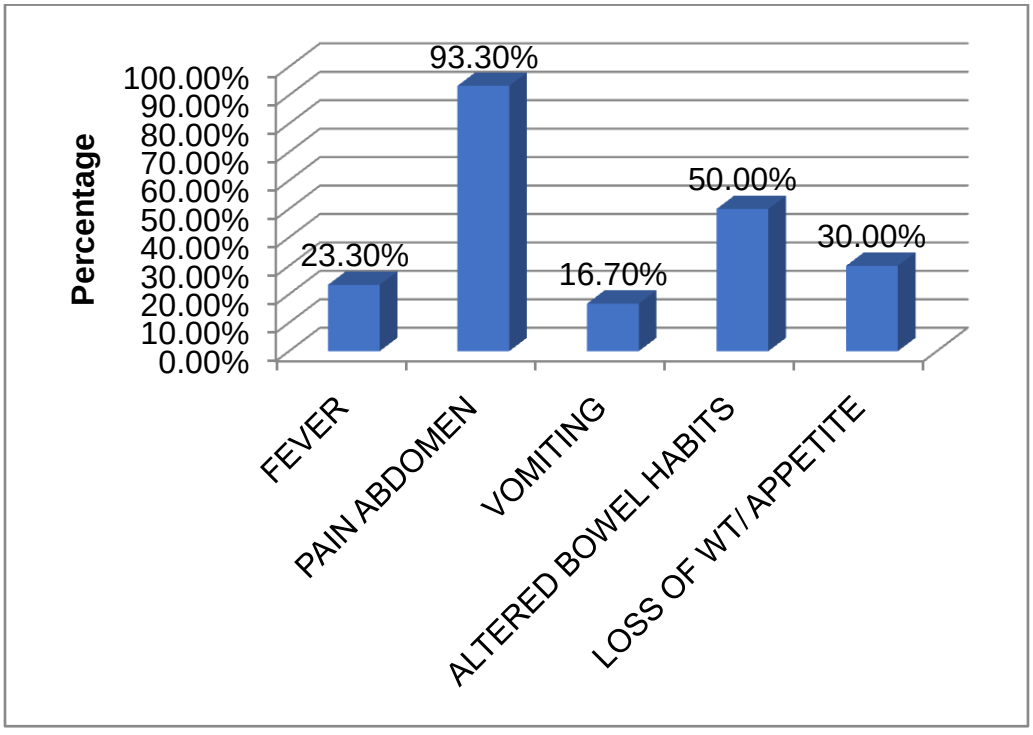


Figure 3: Clinical presentation of patients

3. CT FINDINGS

3.1 Intestinal involvement

Focal intestinal involvement was present in 87.5% of malignant cases and 59.1% of benign cases (p=0.144). Multifocal intestinal involvement was seen in 40.9% of benign cases and 12.5% of malignant cases (p=0.21). (Table 5, Figure 4)

Table 5: Intestinal involvement

	Benign		Malignant	
	No. of cases	**% age**	**No. of cases**	**% age**
FOCAL	13	59.10%	7	87.50%
MULTIFOCAL	9	40.90%	1	12.50%

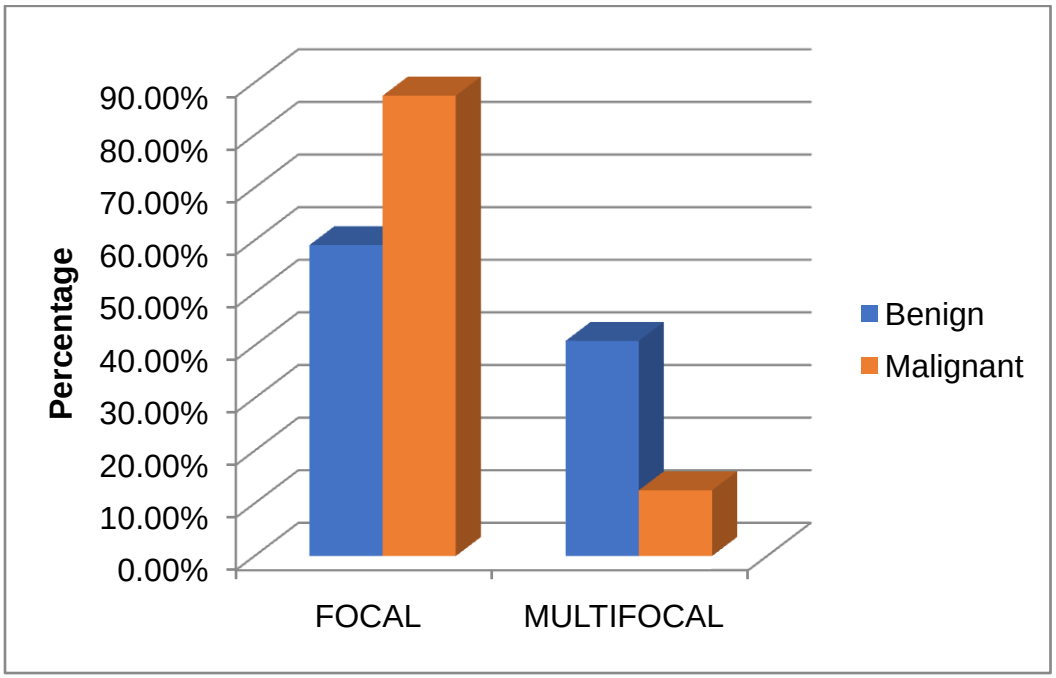


Figure 4: Intestinal involvement

3.2 LENGTH OF INVOLVEMENT

Focal involvement (<5 cm) was seen in 36.4% of the benign cases and 37.5% of malignant cases which was statistically insignificant (p value=0.954). Segmental involvement (6-40 cm) was present in 59.1% of benign cases and 62.5% of malignant cases (statistically insignificant with p value= 0.866). Diffuse involvement (>40 cm) was present in 4.5% of benign cases and 0% of malignant cases (statistically insignificant with p value= 0.54). (Table 6, Figure 5)

Table 6: Length of involvement

	Benign		Malignant	
	No. of cases	% age	No. of cases	% age
FOCAL(<5 cm)	8	36.40%	3	37.50%
SEGMENTAL(6-40 cm)	13	59.10%	5	62.50%
DIFFUSE(>40 cm)	1	4.50%	0	0.00%

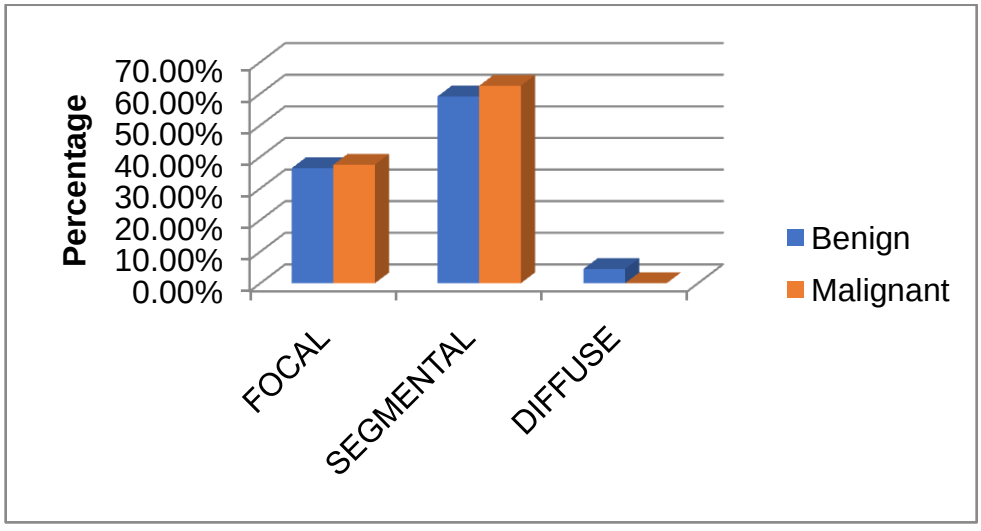


Figure 5: Length of involvement

3.3 Region involved

56.7% of the cases had involvement of the ileum, IC junction and cecum, 33.3% had involvement of ileum and IC junction and 46.7% had involvement of the ascending colon. Isolated involvement of terminal ileum was seen in 13.3% of the cases while none of the cases showed isolated involvement of IC junction (Table 7, Figure 6)

Table 7: Region involved

Region involved	No. of cases	Percentage
Ileum	4	13.3%
IC Junction	0	0.0%
Caecum	1	3.3%
Ileum + IC junction	10	33.3%
Ileum + IC junction + Caecum	17	56.7%
Ascending colon	14	46.7%

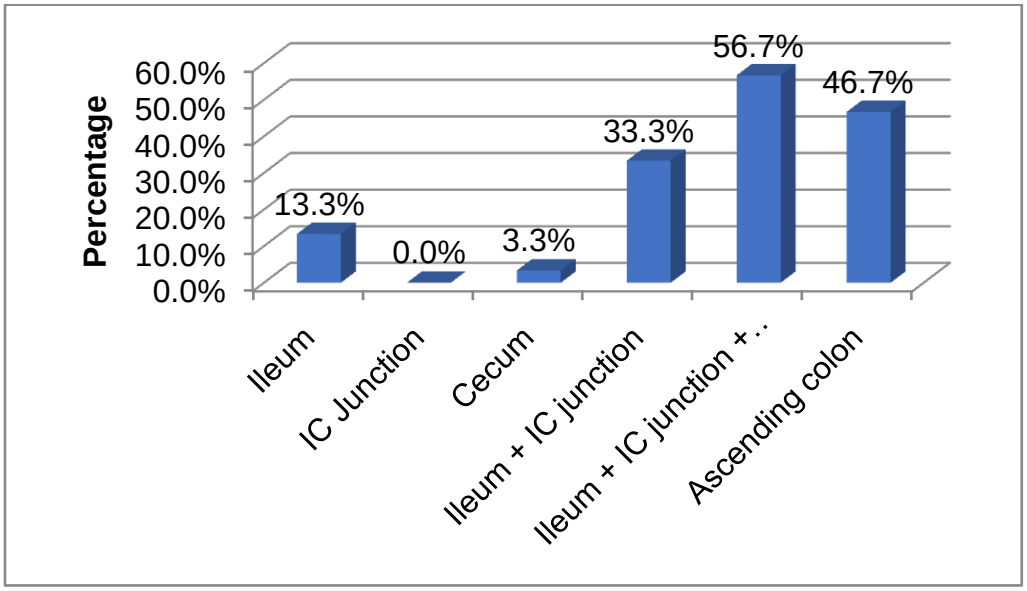


Figure 6: Region involved

3.4 DEGREE OF THICKENING

75% of the malignant cases had bowel wall thickening more than 1 cm as compared to 36.4% of benign cases. 63.6% of benign cases had bowel wall thickening less than 1 cm as compared to 25% of malignant cases. These results were statistically insignificant with p value= 0.101. (Table 8, Figure 7).

Table 8: Degree of thickening

		Benign		Malignant	
		No. of cases	**% age**	**No. of cases**	**% age**
DEGREE OF THICKENING	> 1 cm	8	36.4%	6	75.0%
	< 1 cm	14	63.6%	2	25.0%

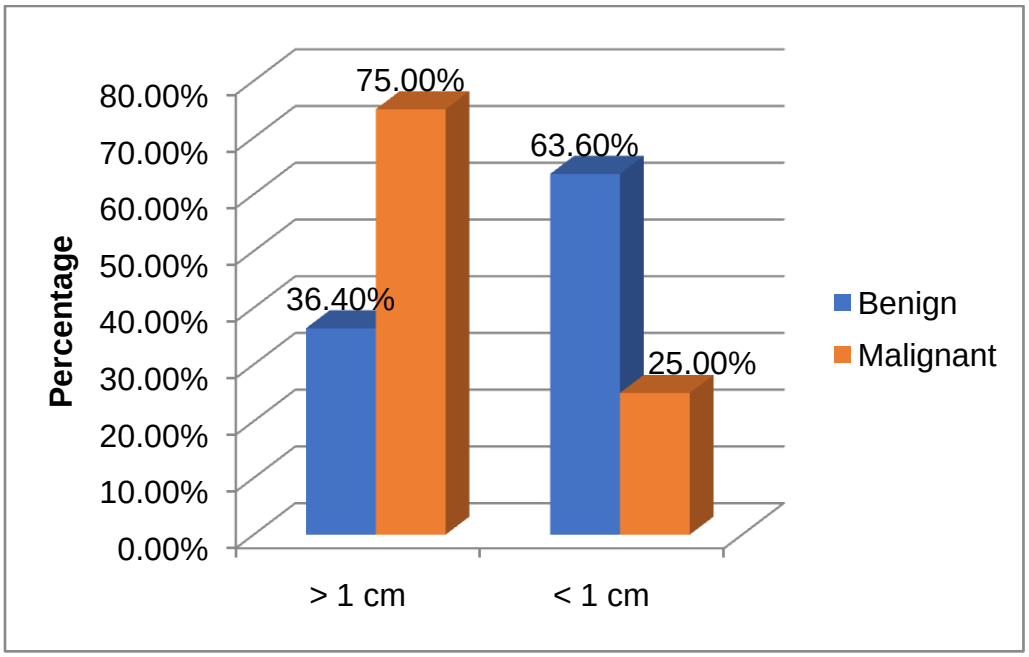


Figure 7: Degree of thickening

3.4 BOWEL WALL THICKENING

Symmetrical bowel wall thickening was more common in benign cases while asymmetrical thickening was more common in malignant cases. Symmetrical thickening was seen in 40.9% of benign and 12.5% of malignant cases (p-value = 0.210). Asymmetrical bowel wall thickening was seen in 87.5% of malignant cases and 59.1% of benign cases (p value= 0.210). (Table 9, Figure 8)

Table 9: Bowel wall thickening

	Benign		Malignant	
	No. of cases	**% age**	**No. of cases**	**% age**
SYMMETRICAL	9	40.90%	1	12.50%
ASYMMETRICAL	13	59.10%	7	87.50%

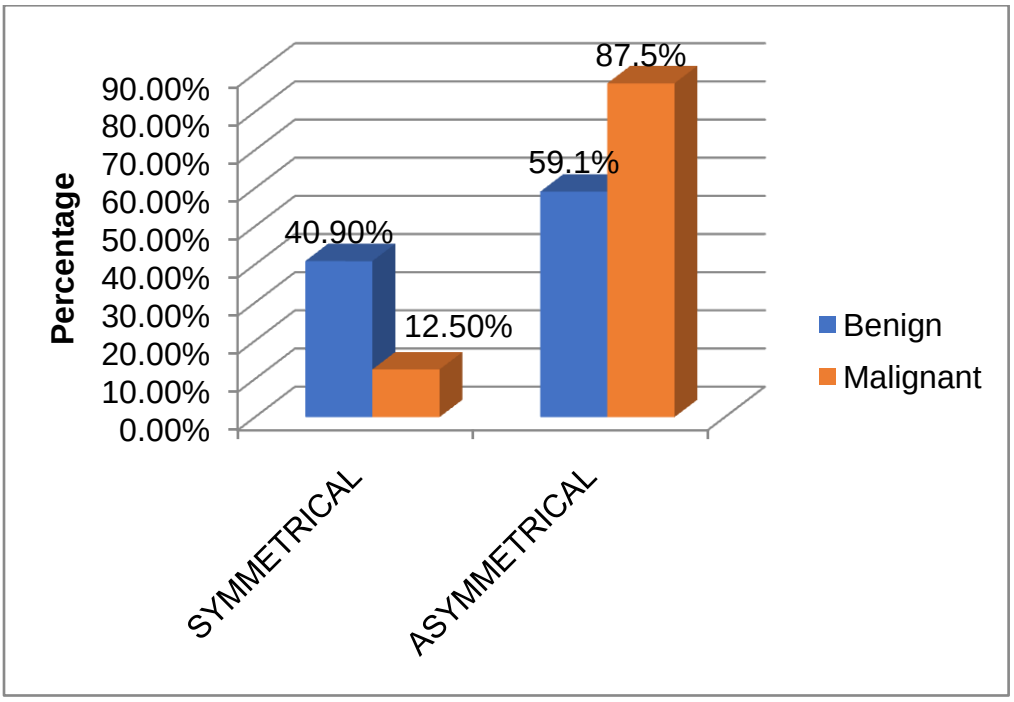


Figure 8: Degree of thickening

3.5 PATTERN OF ENHANCEMENT

Majority of the malignant cases had heterogeneous enhancement and benign cases had homogenous enhancement Heterogenous enhancement was seen in 75% of malignant and 36.4% of benign cases (p= 0.101). 40.9% of benign cases had homogeneous enhancement was present in 40.9% of benign cases and 25% of malignant cases. (p= 0.672). Stratified enhancement was present in 22.7% of benign cases, however, none of the malignant cases showed stratified enhancement (p= 0.287). (Table 10, Figure 9)

Table 10: Pattern of enhancement

	Benign		Malignant	
	No. of cases	**% age**	**No. of cases**	**% age**
HETEROGENOUS	8	36.40%	6	75.00%
STRATIFIED	5	22.7%	0	0.00%
HOMOGENOUS	9	40.90%	2	25.00%

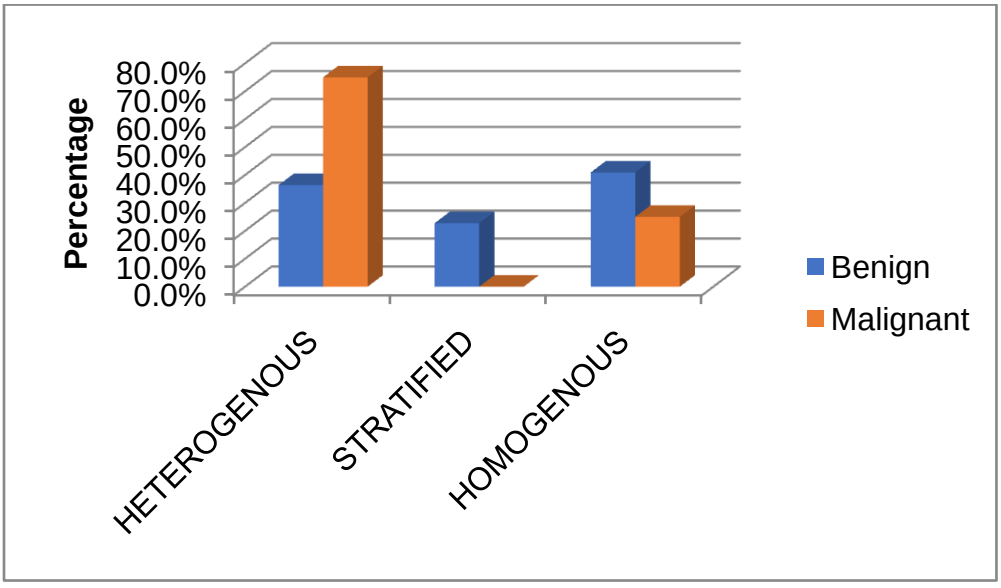


Figure 9: Degree of thickening

3.6 LYMPH NODE INVOLVEMENT

90.9% of benign cases and 87.5% of malignant cases had lymph node involvement (p= 0.783). 62.5% of malignant cases had necrotic lymph nodes as compared to 22.7% in benign cases (p= 0.078). Calcification was seen in 9.1% of benign cases, however, none of the malignant cases showed calcified lymph nodes. Homogeneous enhancement was seen in 68.2% of benign cases as compared to 37.5% of malignant cases (p= 0.210). (Table 11a, Figure 10a)

59.1% of benign cases had lymph nodes size < 10 mm as compared to 25% of the cases. In 75% of the malignant cases, lymph node size was> 10 mm as compared to 40.9% in malignant cases (p= 0.215). (Table 11b, Figure 10b)

Figure 11a: Lymph node involvement

	Benign		**Malignant**	
	No. of cases	**% age**	**No. of cases**	**% age**
LYMPH NODE INVOLVEMENT	20	90.90 %	7	87.50%
NECROSIS	5	22.70 %	5	62.50%
CALCIFICATION	2	9.10%	0	0.00%
HOMOGENOUSLY ENHANCING	15	68.20 %	3	37.50%

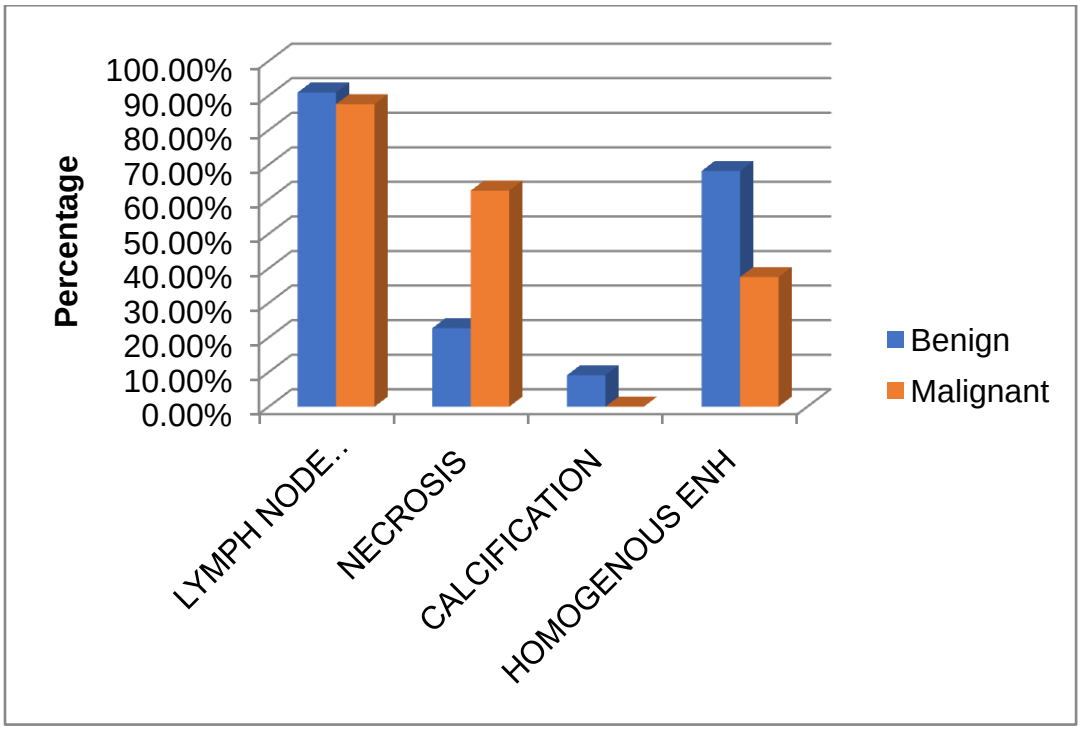


Figure 10a: Lymph node involvement

Table 11b: Lymph node size

		Benign		**Malignant**	
		No. of cases	**% age**	**No. of cases**	**% age**
LN SIZE	> 10 mm	9	40.90%	6	75.00%
	< 10 mm	13	59.10%	2	25.00%

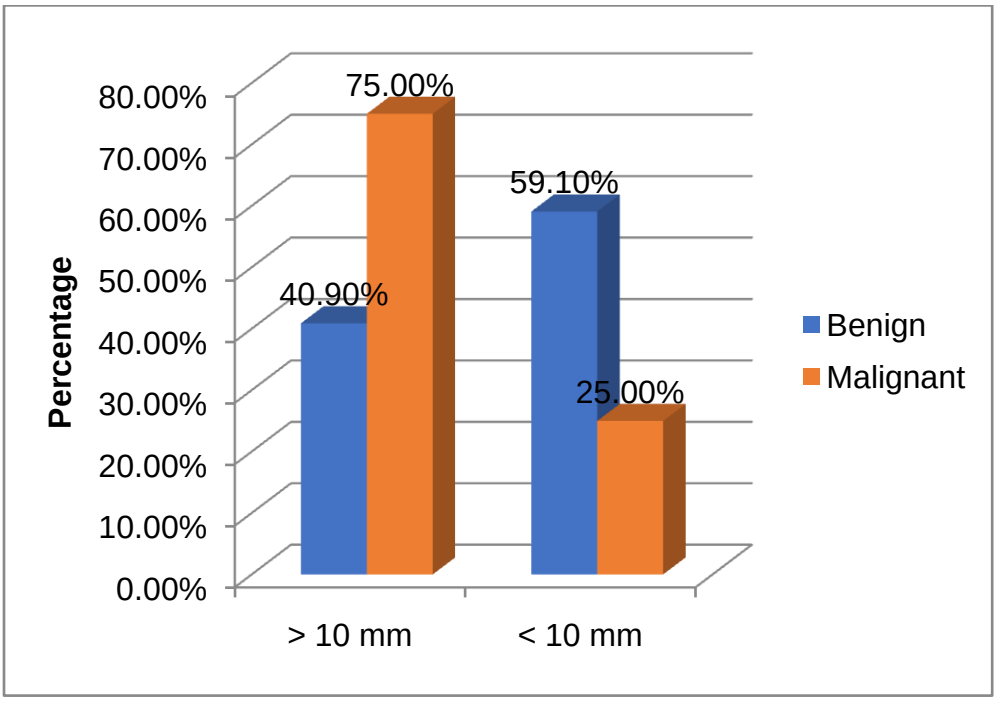


Figure 10b: Lymph node size

3.7 MESENTERIC FAT STRANDING

Mesenteric fat stranding was present in 81.8% of benign and 100% of malignant cases with p-value of 0.550. (Table 12, Figure 11)

Table 12: Mesenteric fat stranding

		Benign		Malignant	
		No. of cases	**% age**	**No. of cases**	**% age**
MESENTERIC FAT STRANDING	-	4	18.2%	0	0.0%
	+	18	81.8%	8	100.0%

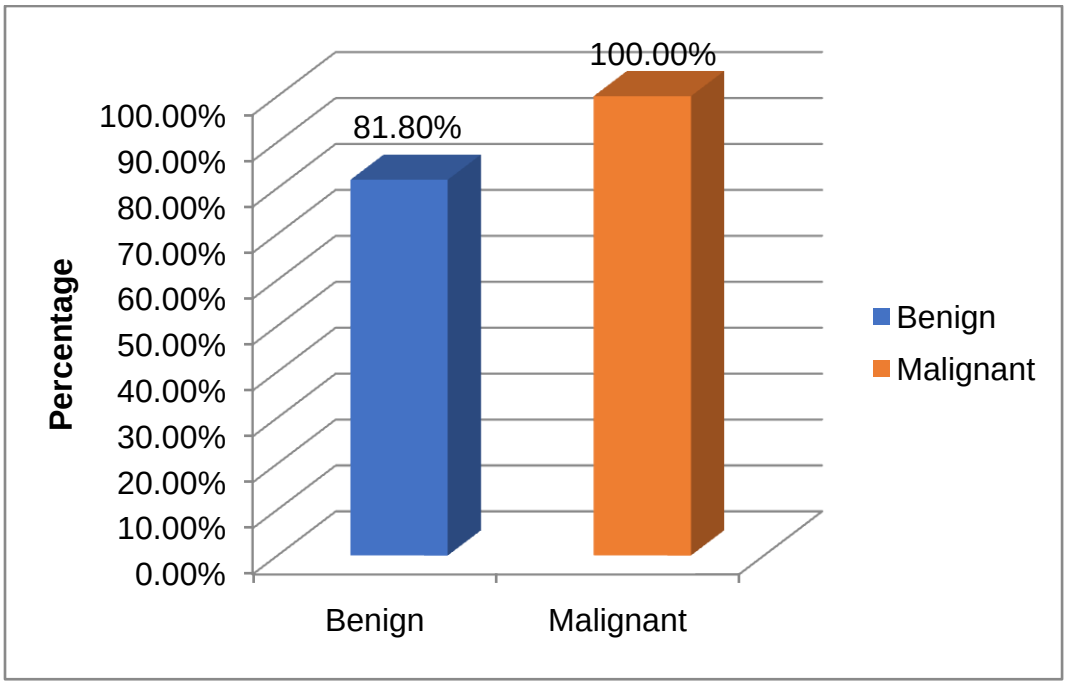


Figure 11: Mesenteric fat stranding

3.8 ABSCESS AND SINUS TRACTS

Abscess and sinus tract formation were more common in malignant cases. It was present in 25% of malignant cases as compared to 4.5% of benign cases (p= 0.166). (Table 13, Figure 12)

Table 13: Abscess and sinus tracts

		Benign		Malignant	
		No. of cases	% age	No. of cases	% age
ABSCESS & SINUS TRACTS	-	21	95.5%	6	75.0%
	+	1	4.5%	2	25.0%

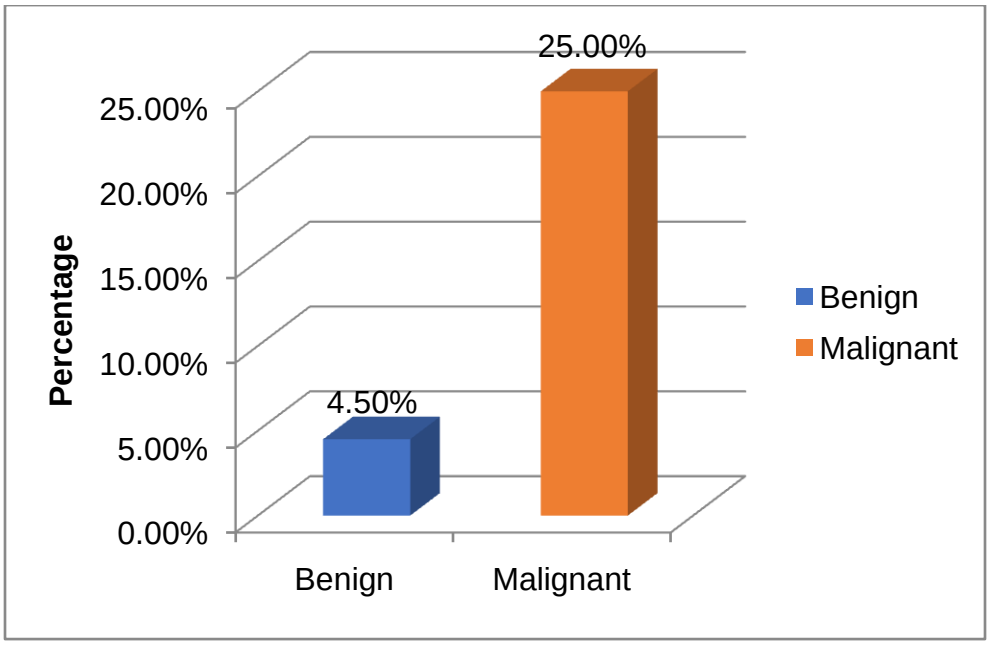


Figure 12: Abscess and sinus tracts

3.9 FAT PROLIFERATION

Fat proliferation was more common in benign cases. It was present in 45.5% of benign cases as compared to 12.5% of malignant cases (p= 0.199). (Table 14, Figure 13)

Table 14: Fat proliferation

		Benign		Malignant	
		No. of cases	**% age**	**No. of cases**	**% age**
FAT PROLIFERATION	-	12	54.5%	7	87.5%
	+	10	45.5%	1	12.5%

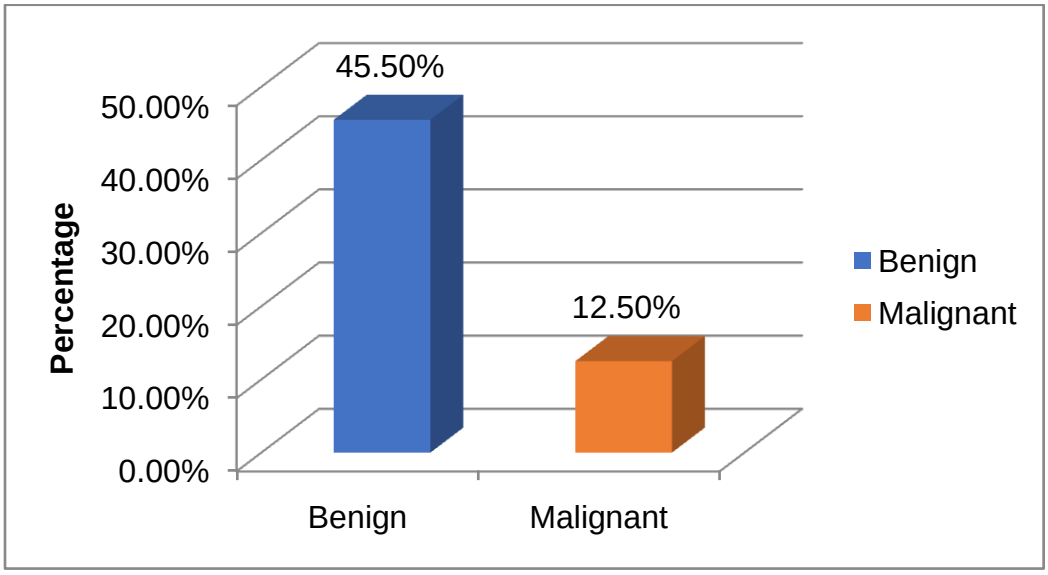


Figure 13: Fat proliferation

3.10 SOLID ORGAN ABNORMALITIES

Solid organ abnormalities help in differentiating between benign and malignant cases. 37.5% of malignant cases and 4.5% of benign cases had solid organ abnormalities making this an important differentiator (p= 0.048). (Table 15, Figure 14)

Table 15: Solid organ abnormalities

		Benign		Malignant	
		No. of cases	**%age**	**No. of cases**	**% age**
SOLID ORGAN ABNORMALITIES	-	21	95.5%	5	62.5%
	+	1	4.5%	3	37.5%

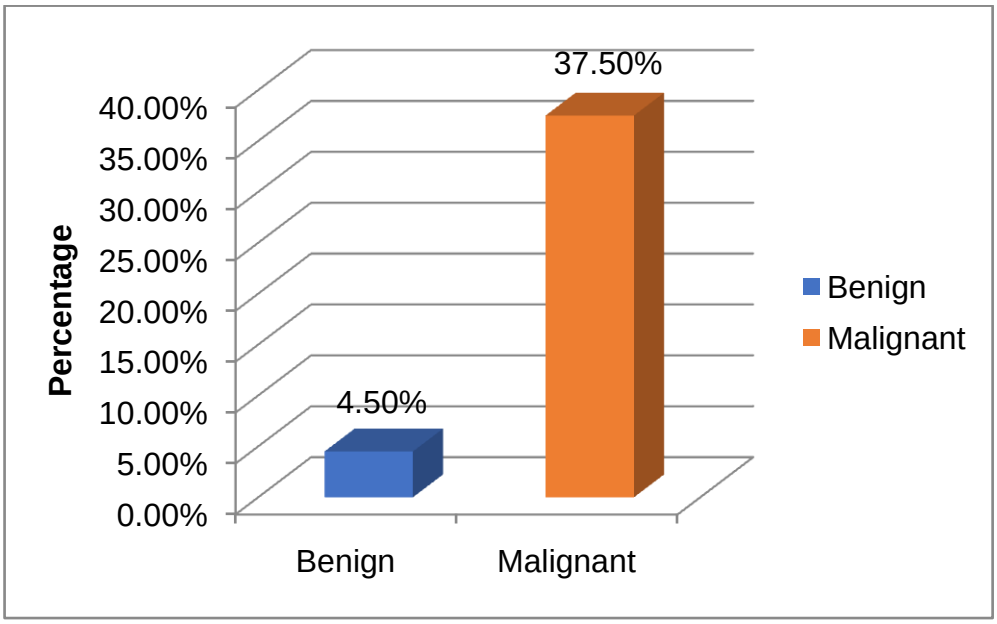


Figure 14: Solid organ abnormalities

3.10 PERITONEAL THICKENING

Peritoneal thickening was present in 50% of the malignant cases and 18.2% of the benign cases. Of the 50% malignant cases who had peritoneal thickening, all of them showed irregular/nodular thickening making this an important differentiator (p= 0.003). Of the 18.2% benign cases who had peritoneal thickening, all the cases showed smooth thickening (p= 0.550). (Table 16, Figure 15)

Table 16: Peritoneal thickening

	Benign		Malignant	
PERITONEAL THICKENING	**No. of cases**	**%age**	**No. of cases**	**%age**
PRESENT	4	18.20%	4	50.00%
SMOOTH	4	18.20%	0	0.00%
IRREGULAR/ NODULAR	0	0.00%	4	50.00%

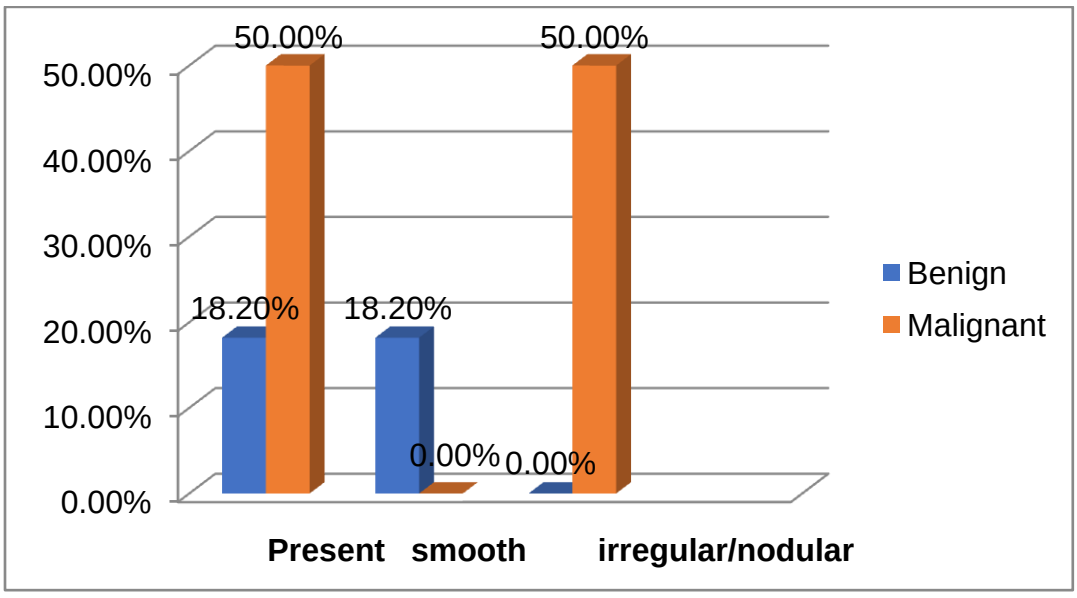


Figure 15: Peritoneal thickening

3.11 ASCITIS

Ascites was present in 27.3% of benign cases and 25% of malignant cases (p= 0.901). (Table 17, Figure 16)

Table 17: Ascites

		Benign		Malignant	
		No. of cases	**% age**	**No. of cases**	**% age**
ASCITIS	-	16	72.7%	6	75.0%
	+	6	27.3%	2	25.0%

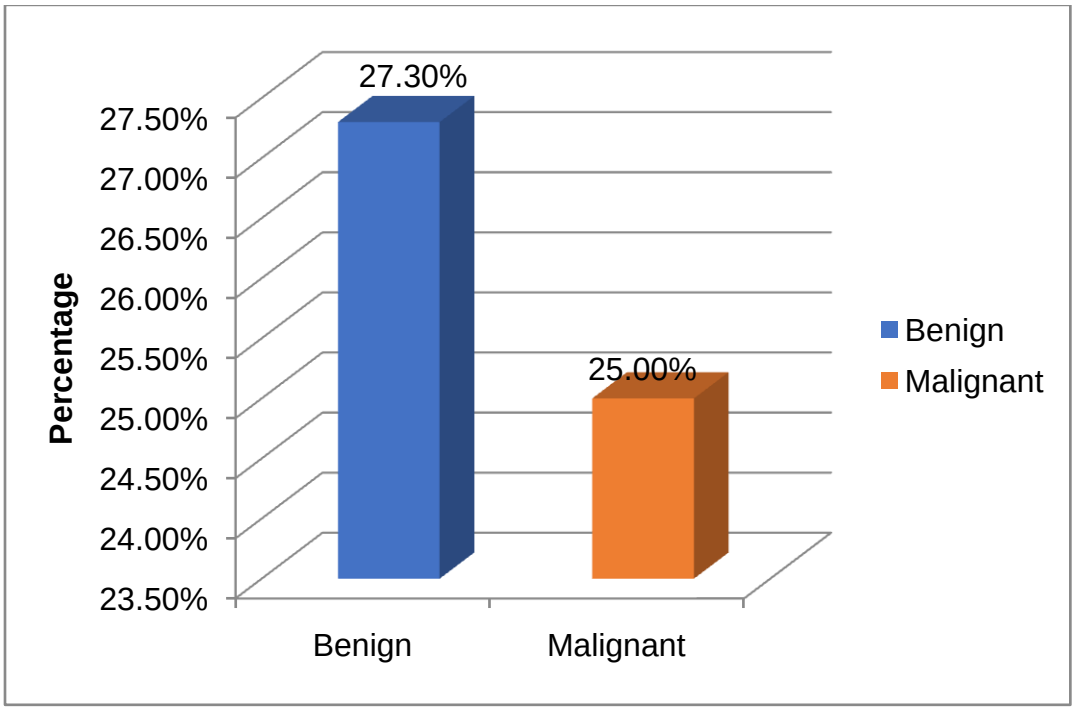


Figure 16: Ascitis

3.12 OMENTAL INVOLVEMENT

Omental disease was more common in malignant cases. It was seen in 50% of malignant cases and 13.6% of benign cases (p= 0.060). (Table 18, Figure 17)

Table 18: Omental disease

		Benign		Malignant	
		No. of cases	% age	No. of cases	% age
OMENTAL DISEASE	-	19	86.4%	4	50.0%
	+	3	13.6%	4	50.0%

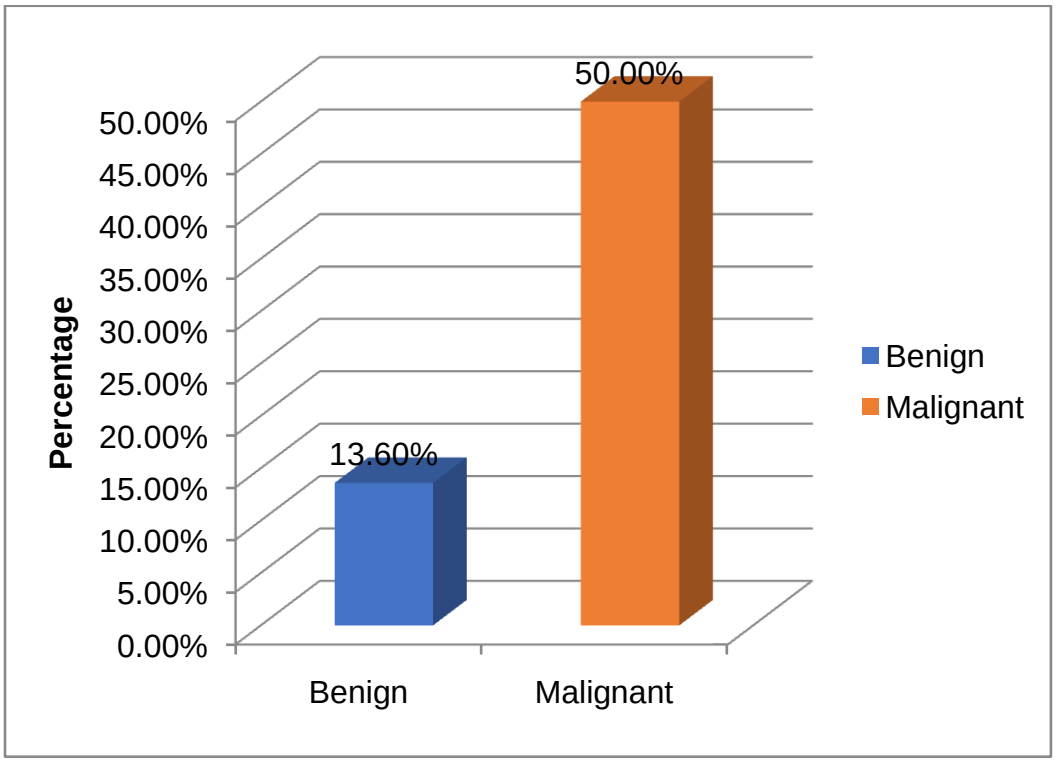


Figure 17: Omental disease

4. CECT DIAGNOSIS

Out of 30 patients who underwent abdominal CECT, the diagnoses were as follows: inflammatory bowel disease (IBD) in 10 patients (33.3%), abdominal tuberculosis in 9 patients (30%), malignancy in 2 patients (6.7%), and lymphoma in 2 patients (6.7%). Three patients (10%) were diagnosed with tuberculosis or inflammatory bowel disease, while 2 patients (6.7%) had underlying malignancy or inflammatory bowel disease. One patient (3.3%) was diagnosed with tuberculosis or lymphoma based on CT findings, and another patient (3.3%) received a diagnosis of malignancy or amoebic colitis based on the CT scan. (Table 19, Figures 18)

Table 19: CECT diagnosis

CECT DIAGNOSIS	No. of cases	Percentage
IBD	10	33.3%
Lymphoma	2	6.7%
Malignant	2	6.7%
Malignant/Amoebic colitis	1	3.3%
Malignant/IBD	2	6.7%
Tuberculosis	9	30.0%
Tuberculosis/IBD	3	10.0%
Tuberculosis/Lymphoma	1	3.3%

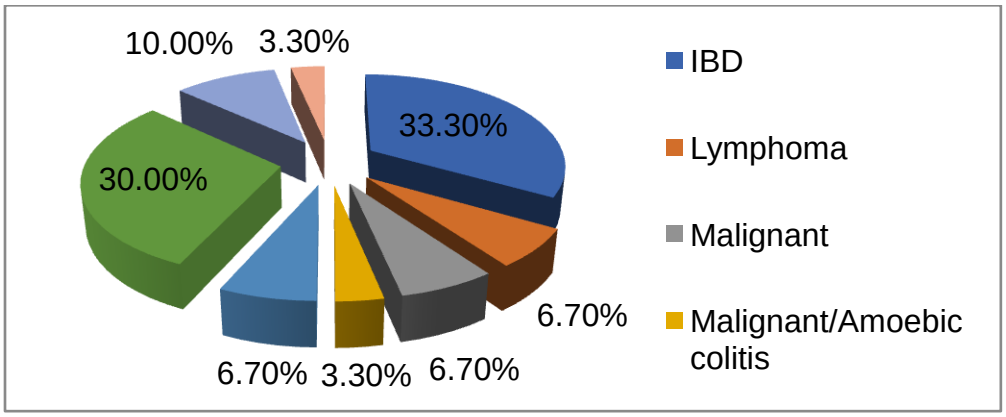


Figure 18: CECT diagnosis

6. COLONOSCOPIC FINDINGS

The most common finding on colonoscopy was deep ulcers seen in 16(46.5%) patients. Other findings observed were nodularity in 6 (20%) patients, aphthous ulcers in 5(16.7%) patients, and stricture in 11(36.7%) patients. (Table 20, Figure 19)

Table 20: Colonoscopic findings

COLONOSCOPIC FINDINGS	No. of cases	Percentage
NODULARITY	6	20%
DEEP ULCERS	16	46.50%
APTHOUS ULCERS	5	16.70%
STRICTURE	11	36.70%
FISTULA	0	0%
FISSURE	0	0%
COBBLESTONE APPEARANCE	0	0%

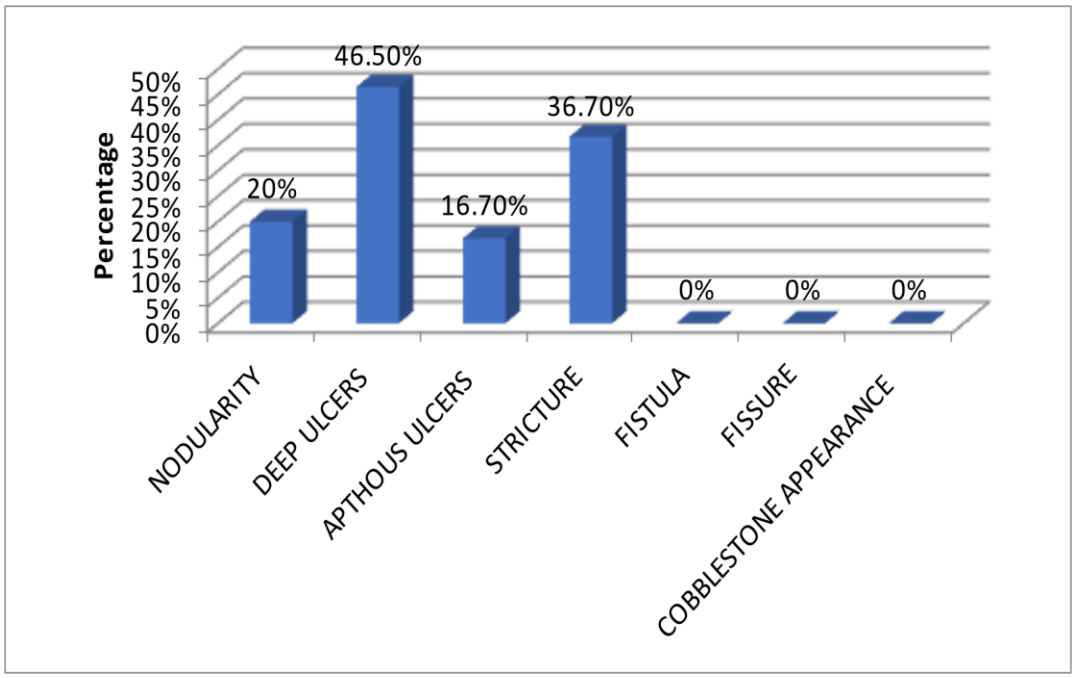


Figure 19: Colonoscopic findings

7. CORRELATION OF CT FINDINGS WITH FINAL DIAGNOSIS

In our study, contrast-enhanced CT (CECT) initially diagnosed benign etiology in 22 cases and malignancy in 4 cases, while 4 cases showed features indicative of both benign and malignant causes. Following comprehensive evaluation including laboratory tests, colonoscopy, and histopathological confirmation, the final diagnoses were abdominal tuberculosis in 30% of cases, inflammatory bowel disease (IBD) in 30%, adenocarcinoma in 13.3%, lymphoma in 6.7%, neuroendocrine tumor in 3.3%, signet ring cell carcinoma in 3.3%, infective colitis in 10%, and ischemic colitis in 3.3%. (Table 21)

Table 21: Correlation of CT findings with Final diagnosis

CECT DIAGNOSIS	No. of cases	Percentage	FINAL DIAGNOSIS	No. of cases	Percentage
Abdominal Tuberculosis	9	30.0%	Abdominal tuberculosis	9	30.0%
IBD	10	33.3%	IBD	9	30.0%
Malignancy	2	6.7%	Adenocarcinoma	4	13.3%
Lymphoma	2	6.7%	Lymphoma	2	6.7%
Malignancy/ IBD	2	6.7%	Neuroendocrine tumor	1	3.3%
Malignancy/ Amoebic colitis	1	3.3%	Signet ring cell ca	1	3.3%
Tuberculosis/ IBD	3	10.0%	infective colitis	3	10.0%
Tuberculosis/ lymphoma	1	3.3%	ischemic colitis	1	3.3%

8. Comparison of CECT findings of Tuberculosis and Inflammatory bowel disease

Contrast-enhanced CT (CECT) findings are valuable in distinguishing between tuberculosis (TB) and inflammatory bowel disease (IBD). In the study, 9 cases were confirmed as TB and 9 as IBD upon final diagnosis. TB commonly exhibited focal intestinal involvement compared to IBD, which more frequently showed multifocal involvement. Specifically, 100% of TB cases and 66.7% of IBD cases presented with focal intestinal involvement, while multifocal involvement was observed in 0% of TB cases and 33.3% of IBD cases. Segmental involvement (6-40 cm) was prominent in 66.7% of TB cases, with 33.3% showing focal involvement (<5 cm), and none had diffuse involvement. In contrast, 66.6% of IBD cases showed segmental involvement, 33.3% had focal involvement, and 11.1% had diffuse involvement. Asymmetrical bowel wall thickening was noted in 66.7% of TB cases and 55.6% of IBD cases, whereas symmetrical thickening was observed in 33.3% of TB cases and 44.4% of IBD cases. Most TB cases exhibited a heterogeneous pattern of enhancement, whereas most IBD cases showed homogeneous or stratified enhancement. Specifically, homogeneous enhancement was present in 44.4% of IBD cases and 22.2% of TB cases, while stratified enhancement was observed in 44.4% of IBD cases and 11.1% of TB cases. Heterogeneous enhancement was found in 66.7% of TB cases and 11.1% of IBD cases.

Extra intestinal manifestations provided further differentiation between TB and IBD. Necrotic lymph nodes were present in 55.6% of TB cases but absent in IBD cases. Conversely, abscesses and sinus tracts occurred in 11.1% of IBD cases but were not seen in TB cases. Fat proliferation was prominent in 88.9% of IBD cases compared to 11.1% of TB cases. Prominent vasa recta were observed in all IBD cases and 33.3% of TB cases. Solid organ abnormalities were noted in 11.1% of TB cases and

none of the IBD cases. Peritoneal thickening was found in 44.4% of TB cases and absent in IBD cases, while ascites was present in 55.6% of TB cases and 22.2% of IBD cases. Omental disease occurred in 44.4% of TB cases but was absent in IBD cases. (Table 22)

Table 22: CECT findings of TB vs IBD

CECT FINDINGS		TB		IBD	
		No. of cases	% age	No. of cases	% age
INTESTINAL INVOLVEMENTS	FOCAL	9	100.0%	6	66.7%
	MULTIFOCAL	0	0.0%	3	33.3%
LENGTH OF INVOLVEMENT	FOCAL(<5 cm)	3	33.3%	2	22.2%
	SEGMENTAL(6-40 cm)	6	66.7%	6	66.7%
	DIFFUSE(> 40 cm)	0	0.0%	1	11.1%
BOWEL WALL THICKENING	SYMMETRICAL	3	33.3%	4	44.4%
	ASYMMETRICAL	6	66.7%	5	55.6%
PATTERN OF ENHANCEMENT	HOMOGENOUS	2	22.2%	4	44.4%
	STRATIFIED	1	11.1%	4	44.4%
	HETEROGENOUS	6	66.7%	1	11.1%
EXTRAINTESTINAL FEATURES	NECROTIC LN	5	55.6%	0	0.0%
	ABSCESS & SINUS TRACTS	0	0.0%	1	11.1%
	FAT PROLIFERATION	1	11.1%	8	88.9%
	PROMINENT VASA RECTA	3	33.3%	9	100.0%
	SOLID ORGAN ABNORMALITIES	1	11.1%	0	0.0%
	PERITONEAL THICKENING	4	44.4%	0	0.0%
	ASCITIS	5	55.6%	2	22.2%
	OMENTAL DISEASE	4	44.4%	0	0.0%

9. SENSITIVITY AND SPECIFICITY OF CECT

Out of 22 cases initially diagnosed as benign on CECT, 19 (86.4%) were confirmed as benign upon final diagnosis. Among the 4 cases initially diagnosed as malignant on CECT, 3 (37.5%) were confirmed as malignant upon final diagnosis. The remaining 4 cases that were indeterminate on CECT yielded 2 (9.1%) benign and 2 (25.0%) malignant diagnoses on final evaluation. Therefore, CECT significantly distinguishes between benign and malignant causes of ileocaecal wall thickening compared to final diagnosis (p= 0.020). (Table 23)

Upon comparing CECT findings with final diagnoses, the sensitivity for detecting benign cases was 95%, with a specificity of 50%. The positive predictive value (PPV) and negative predictive value (NPV) were 86.36% and 75%, respectively. (Table 24) For malignant cases, CECT showed a sensitivity of 50% and specificity of 95%, with PPV and NPV values of 75% and 86.36%, respectively. Overall, the diagnostic accuracy of CECT in detecting ileocaecal pathologies was 84.62%. (Table 25)

Table 23: correlation of CT diagnosis of benign vs malignant with the final diagnosis

	Final Diagnosis- Benign		**Malignant**	
CECT DIAGNOSIS	**No. of cases**	**% age**	**No. of cases**	**% age**
Benign	19	86.4%	3	37.5%
Benign/ Malignant	2	9.1%	2	25.0%
Malignant	1	4.5%	3	37.5%
Total	22	100.0%	8	100.0%

Table 24: sensitivity and specificity of CECT in benign cases

	Benign	
Statistics	Value	95% CI
Sensitivity	95.00%	75.13% to 99.87%
Specificity	50.00%	11.81% to 88.19%
PPV	86.36%	73.87% to 93.42%
NPV	75.00%	27.44% to 95.97%
Accuracy	84.62%	65.13% to 95.64%

Table 25: sensitivity and specificity of CECT in malignant cases

	Malignant	
Statistics	Value	95% CI
Sensitivity	50.00%	11.81% to 88.19%
Specificity	95.00%	75.13% to 99.87%
PPV	75.00%	27.44% to 95.97%
NPV	86.36%	73.87% to 93.42%
Accuracy	84.62%	65.13% to 95.64%

DISCUSSION

The introduction of Multidetector helical scanning has enhanced the detection of abnormal gastrointestinal findings on CT scans, with bowel wall thickening being a prominent abnormality observed. This thickening can indicate various underlying conditions such as inflammation, infection, ischemia, or neoplastic growth. Occasionally, bowel wall thickening may appear normal. Numerous studies have investigated the significance of bowel wall thickening, consistently recommending colonoscopy and biopsy for definitive diagnosis due to the likelihood of underlying diseases in most cases. Ileocolonoscopy plays a crucial role in diagnosis by allowing direct visualization and tissue sampling. Endoscopy is particularly emphasized due to the elevated risk of colon neoplasms. While histopathology remains the gold standard, it may yield nonspecific findings, posing challenges in definitive diagnosis. Therefore, a systematic approach integrating clinical, biochemical, radiological, endoscopic, histological, and other laboratory tests is essential for accurate diagnosis.

The present study was a prospective study of 30 patients of all age groups diagnosed with bowel wall thickening on MDCT attending OPD or admitted to DMCH. After taking relevant history and thorough clinical examination, MDCT abdomen was advocated. This study was an endeavour to characterize the ileocaecal pathologies in patients undergoing MDCT abdomen and further correlating the MDCT findings with clinical, endoscopy findings and histopathology wherever possible.

CT is highly effective in distinguishing between benign and malignant causes of abnormal bowel wall thickening. Features such as heterogeneous enhancement patterns, focal or segmental bowel wall involvement, significant thickening of the bowel wall and asymmetrical lesions contribute to a high specificity in identifying malignant lesions.

Radiologists should recognize the importance of these specific CT criteria for bowel wall thickening to improve differentiation between benign lesions and those that may be malignant or require further diagnostic investigation.

Radiologically, both ileocaecal tuberculosis and Crohn's disease present as symmetrical thickening of the ileocaecal region. However, multiple long-segment eccentric strictures with mural stratification, interbowel fistulae, perianal fistulae, increased mesenteric vascularity and fibrofatty proliferation favour Crohn's disease over tuberculosis. On the contrary, the presence of ascites, omental involvement, abdominal cocoon formation, bulky abdominal lymphadenopathy and enteroliths suggest ileocaecal TB over Crohn's disease. [36-38] Adenocarcinomas usually present as short segment marked thickening of caecum without stratified pattern or fat stranding. [31]

In the current study, the age range of patients was from 9-74 years, the incidence of the disease was highest in the age group between 41-50 years with a mean age of 45.30 + /-15.93.

Ritu N.Misra, Sunil Kr. Bajaj et al (2018) conducted a study on 30 patients and found that a majority of the patients were within the age group of 21-30 years. Mean age of the patients was 31.03 years. [61] Anshul Chamail et al (2018) conducted a study on 65 patients and found the age range of the patients between 16-70 years. The mean age of presentation was 40.26 years. [60] Mona El-Kalioubie, Rasha Ali et al (2015) conducted a study on 50 patients and found the age range of the patients between 12-75 years. The mean age of presentation was 40.26 years. [53] Age distribution was more or less comparable with Anshul Chamail et al (2018) and Mona El-Kalioubie, Rasha Ali et al (2015). Discordance with other studies reflects variation in etiological spectrum which differs from region to region.

MDCT Findings

Length of involvement

Pathological conditions typically result in focal involvement (less than 5 cm), segmental involvement (6-40 cm), or diffuse involvement (more than 40 cm) of the bowel wall. When thickening is focal, additional factors such as the symmetry and homogeneity of the thickening, as well as peri enteric findings can help narrow down the diagnosis. Focal thickening is commonly linked to malignancies, with the exception of lymphoma. Malignancies often exhibit asymmetrical and heterogeneous focal thickening. However, certain inflammatory conditions may also present with focal thickening of the bowel wall.

In our study, focal involvement (less than 5 cm) was seen in 36.4% of benign and 37.5% of malignant cases. Segmental involvement (6-40 cm) was seen in 59.1% of benign and 62.5 % of malignant cases. Diffuse involvement (more than 40 cm) was seen in 4.5% of benign cases. None of the malignant cases showed diffuse involvement.

In a study conducted by Anshul Chamail et al., focal thickening of bowel wall was caused by both tuberculosis and adenocarcinoma. caused focal thickening of the bowel wall. Malignancy was associated with focal thickening in the majority (54%) of cases. For tubercular cases, the majority (54%) exhibited segmental thickening. [60] In a study conducted by Tapasvi et al., (2014), findings of focal or segmental intestinal involvement of the bowel wall strongly indicated malignancy. Among the 26 cases with focal bowel involvement, 22 were classified as malignant. Similarly, among the 17 cases with segmental bowel involvement, 12 were found to be malignant.[62]

Degree of thickening

Ilangovan et al. categorized bowel wall thickening into three grades: mild (3-4 mm), observed in conditions like infectious enteritis and mild Crohn's disease; moderate (5-9 mm), seen in Crohn's disease, early adenocarcinoma, and lymphoma; and severe (more than 10 mm), typically associated with advanced Crohn's disease and various neoplasms including lymphoma. [63]

In current study, 63.6% of benign cases and 25% of malignant cases showed mild to moderate thickening (less than 10 mm) while 36.4% of benign and 75% of malignant cases showed marked thickening (more than 10 mm). This was in concordance with the study conducted by Hasan I. Megally et al., where 81.8% of patients in the non-neoplastic group exhibited mild to moderate bowel wall thickening. In contrast, 76.5% of patients in the neoplastic group displayed marked bowel wall thickening. [54]

In a study by Anshul Chamail et al, out of 65 patients, 32 patients had wall thickness greater than 5 mm (moderate and marked). Moderate thickening was mainly seen in benign cases like tuberculosis, while marked thickening was seen in malignancies, however tuberculosis (9.37%) and non-specific enteritis (6.25%) also caused marked thickening. [60]

Symmetrical vs Asymmetrical thickening

According to Teresa Fernandes et al., focal, irregular, and asymmetrical thickening of the bowel wall indicates malignancy. Conversely, regular, symmetrical, and homogeneous wall thickening is more commonly associated with benign conditions, although it can also occur in neoplasms such as well-differentiated adenocarcinoma and lymphoma. [64]

In our study, symmetrical bowel wall thickening are seen in 40.9% of benign and 12.5% of malignant cases. Asymmetrical bowel wall thickening was seen in 59.1% of benign and 87.5% of malignant cases.

In a study by Hasan I. Megally et al**,** among the Non-neoplastic group of patients, symmetrical thickening was seen in 81.8% of the cases. In this study, the entire neoplastic Group of patients showed asymmetrical type of thickening. [54]

In a study conducted by Anshul Chamail et al, malignancy was associated with marked asymmetrical thickening in 81% of cases. [60]

Pattern of enhancement

According to R Ilangovan et al small bowel wall enhancement patterns have been divided into target pattern, homogeneous, heterogeneous and diminished.[63]

According to Teresa Fernandes et al., when there is segmental or diffuse thickening of the bowel wall, one of three types of attenuation patterns may be observed following intravenous contrast administration: Stratified, white, or grey attenuation patterns. [64]

In our study, 75% of malignant and 36.4% of benign cases showed heterogeneous enhancement. Homogeneous enhancement was seen in 40.9% of benign and 25% of malignant cases. Stratified enhancement was seen in 22.7% of benign cases had stratified enhancement whereas none of the malignant cases showed stratified enhancement.

In a study by Varma RU et al, majority of the patients had a target pattern of enhancement (37.25%) followed by homogeneous pattern of enhancement (29.41%). Among the patients with benign lesions, 46.34% had target enhancement whereas in those with malignant neoplasms, a heterogeneous enhancement pattern was noted in all the cases (100%). This was in concordance with our study in which most of the malignant

cases had heterogeneous enhancement and majority of the benign cases had homogeneous or target pattern of enhancement. [58]

In a study by Anshul Chamail et al, out of 32 patients with pathology involving the bowel wall, homogeneous enhancement was seen in benign pathologies like tuberculosis (n=18), while heterogeneous enhancement was seen predominantly in malignancies (n=10). Bilaminar stratification and de-enhancement pattern was seen in 1 case each having non-specific enteritis and ischaemic bowel disease respectively. [60]

In a study by Ritu N.Misra, Sunil Kr.Bajaj, enhancement pattern of bowel wall was characterised as hyperenhancement or mural stratification. Out of 17 patients with bowel wall thickening, 14 cases showed hyperenhancing pattern and 3 cases had mural stratification. [61]

Extraintestinal Features

Lymph nodes were considered significant if they measured more than 10 mm in short-axis dimension. In our study, Mesenteric lymph nodes were present in 90.9% (n=20) of benign and 87.5% (n=7) of malignant cases. However, 40.9% (n=9) of benign and 75% (n=6) of malignant cases had significant lymphadenopathy. Homogeneous enhancement of lymph nodes was seen in 68.2% (n=15) of benign and 37.5% (n=3) of malignant cases. Necrosis of lymph nodes was seen in 62.5% (n= 5) of malignant and 22.7% (n= 5) of benign cases. Calcification of lymph nodes was seen in 9.1% of benign cases (n= 2) and none of the malignant cases.

Proliferation of fat in the surrounding mesentery was more common in benign cases (45.5%) as compared to malignant cases (12.5%). Mesenteric fat stranding was present in 81.8% of benign and 100% of malignant cases. Abscess and sinus tract formation were more common in malignant cases as compared to benign cases. 25% of malignant cases and 4.5% of benign cases had abscess and sinus tract formation. Solid

organ abnormalities were seen in 37.5% of malignant and 4.5% of benign cases.

Peritoneal thickening was present in 50% of malignant and 18.2% of benign cases. Of the malignant cases that had peritoneal thickening, all of them showed irregular/nodular thickening. Of the benign cases, all the cases showed smooth thickening.

Ascites was seen in 27.3% of benign and 25% of malignant cases. Omental involvement was seen in 50% of malignant cases and 13.6% of benign cases. Extraintestinal manifestations are an important differentiator between TB and IBD. Necrotic lymph nodes were seen in 55.6% of TB and none of the IBD cases. Abscess and sinus tracts were seen in 11.1% of IBD and none of the TB cases. Fat proliferation was seen in 88.9% of IBD and 11.1% of TB cases. Prominent vasa recta were seen in 100% of IBD and 33.3% of TB cases. Solid organ abnormalities were seen in 11.1% of TB and none of the IBD cases. Peritoneal thickening was seen in 44.4% of TB and none of the IBD cases. Ascitis was seen in 55.6% of TB and 22.2% of IBD cases. Omental disease was seen in 44.4% of TB and none of the IBD cases.

In a study conducted by Ahmed Mostafa Mohamed et al., to assess Crohn's disease (CD) activity using CT enterography, extraintestinal findings such as engorged vasa recta, fat edema, and lymph node enlargement effectively differentiated between moderate and severe CD. Moderate disease was accurately identified by CTE in 50% of cases, whereas severe disease was identified in 100% of cases. The study suggested that if two or more of the following are present—engorged vasa recta, fat edema, and lymph node enlargement—the CTE findings classify the disease as "severe", correlating with histological results with higher sensitivity (80%) in predicting moderate disease activity. [65]

Ahmed Mostafa mohamed et al in their study found engorged vasa recta in 14 patients (53%), enlarged lymph nodes in 9 patients (35%) in Crohn's disease. They also observed fat stranding in 19 patients (75%). In our study among the 9 cases of Crohn's disease, engorged vasa recta was seen in all cases, enlarged lymph nodes in 4 (44.4%) cases and fat stranding in 8 (88.8 %) cases. 4 of the 9 (44.4%) cases had all three findings indicative of the active nature of the disease. [65]

According to Varma RU et al. Extra-intestinal findings are also helpful indicators of active disease. The "comb sign" describes the engorged vasa recta within the mesentery that run perpendicular to the bowel wall and correlates with more advanced and active disease that may warrant more aggressive medical therapies. An increase in the density of the mesenteric fat surrounding an abnormal loop of bowel is found to correlate with elevated C-reactive protein levels and histopathologic severity of disease. Fibrofatty proliferation or fatty deposition along the mesenteric border of inflamed bowel segments is highly specific for transmural inflammation secondary to Crohn's disease but can be seen with both active and chronic disease. Other important extra-enteric findings include abscesses and fistulas, as these may determine a need for surgical intervention. [58]

According to Ilangovan et al, lymphadenopathy in the mesentery can give an important clue to the presence of underlying disease, both benign and malignant. In intestinal tuberculosis, for example, the lymph nodes have a central low attenuation, while in lymphoma and Crohn's disease the nodes are usually of soft tissue density. [63]

A study by Zhao et al on patients with ITB stated that lymphadenopathy was one of the common manifestations of ITB. The most prevalent and characteristic CTE finding of diseased LN was rim enhancement with a low-density center, representing peripheral inflammatory reactions and central caseous necrosis, an imaging appearance highly suggestive of ITB although other conditions (metastasis, Whipple's disease, lymphoma,

mycobacterium avium-intracellulare infections) could also have a similar appearance.In the study (LNs) was found in 13 (87%) tuberculosis patients. Non-enhancing central necrosis and rim enhancement were noted in 10 tuberculosis patients (67 %). [36] In our study, 5 out of the 9 (55.5%) tubercular cases showed necrosis in the lymph nodes. This was in close concordance with the study by Zhao et al.

Zhao et al also observed ascites in 3 (20%), mesenteric thickening and hypervascularity (comb sign) in 2(13.3%) cases, suggesting that the comb sign is not a unique sign of Crohn's disease. [36]

Misra RN et al observed lymphadenopathy in 13 patient (63.3%) out of which 8 patients (26.6%) had necrotic changes. They also observed ascites in 8 patients (26.6%) out of total 30 patients in their study of small bowel pathology. [61]

Comparison of distribution of statistical measurements of MDCT abdomen in various studies

In our study, the MDCT diagnosis of ileocaecal thickening included 22 benign and 4 malignant cases. The remaining 4 cases showed CT signs of both benign and malignant aetiology which could not be confirmed on MDCT abdomen. CT diagnosis of IBD was made in 10 patients (33.3%), TB in 9 (30%), malignancy in 2 (6.7%) and lymphoma in 2 patients (6.7%). In 3 patients (10%) diagnosis of TB/IBD was given. 2 patients (6.7%) showed signs of both IBD and malignancy which could be confirmed on MDCT. In 1 patient (3.3%), a CT diagnosis of TB/lymphoma was given and in 1 patient (3.3%) diagnosis of malignancy/ amoebic colitis was given.

After compiling and comparing adequate laboratory, endoscopic and histopathological diagnoses, the final diagnosis was TB in 9 (30%), IBD in 9 (30%), adenocarcinoma in 4 (13.3%), lymphoma in2 (6.7%), neuroendocrine tumour in 1 (3.3%), signet ring cell carcinoma in 1 (3.3%), infective colitis in 3 (10%) and ischaemic colitis in 1patient (3.3%).

Based on the comparison of MDCT and final diagnosis, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated. In our study, MDCT showed a sensitivity of 95%, specificity of 50%, positive predictive value of 86.36% and negative predictive value of 75% for benign cases. For malignant cases, the sensitivity was 50%, specificity was 95%, positive predictive value was 75% and negative predictive value was 86.36%. The diagnostic accuracy of MDCT abdomen in detection of ileocaecal pathologies was 84.62%.

In a study by Masseli et al the overall sensitivity, specificity and accuracy of CT enterography in identifying patients with small bowel lesions was 75.9%, 94.8% and 88% respectively. [55]

Another study by Tapasvi et al, showed a sensitivity of 97% and specificity of 93% of CT enterography in differentiating between benign and malignant aetiology of abnormal bowel wall thickening. [62]

In a study by Varma et al, the sensitivity of CT enterography for non neoplastic disease, benign neoplasm and malignant neoplasm was 93.7%, 66.6% and 83.3% respectively. The specificity for non neoplastic disease, benign neoplasm and malignant neoplasm was 72.2, 66.6 and 67% respectively. [58]

The difference in sensitivity and specificity in current study could be due to the small sample size in current study.

LIMITATIONS

Although the results from our current study are encouraging, a small number of patients were included in each group and subgroup of benign and malignant ileocaecal pathology. Henceforth, a large sample size would be necessary to further establish the role of MDCT abdomen in characterization of Ileocaecal pathologies and differentiating between benign and malignant causes.

CONCLUSION

Due to its high accuracy in distinguishing between benign and malignant causes of ileocaecal thickening, MDCT is an excellent imaging method. It not only evaluates small bowel pathologies within the wall and lumen but also identifies extraintestinal features crucial for accurate diagnosis. MDCT effectively visualizes small bowel inflammation associated with ileocaecal tuberculosis or Crohn's disease, revealing hyperenhancement, stratification, thickening of the bowel wall, engorged vasa recta, and inflammatory changes outside the intestine. Most patients with ileocaecal wall thickening detected on MDCT have an underlying condition, warranting further investigation with ileocolonoscopy and biopsy.

BIBLIOGRAPHY

1. Fleischner FG, Bernstein C. Roentgen-anatomical studies of the normal ileocaecal valve. Radiology. 1950; 54: 43–58

2. Horvath KD, Whelan RL. Intestinal tuberculosis: return of an old disease.Am. J. Gastroenterol. 1998; 93: 692–6.

3. Moss JD, Knauer CM. Tuberculous enteritis. A report of three patients. Gastroenterology. 1973; 65: 959–66.

4. Kumar A, Rana SS, Nada R, Kalra N, Sharma RK, Dutta U, et al. Significance of ileal and/or cecal wall thickening on abdominal computed tomography in a tropical country. JGH Open. 2018;3:46-51.

5. Min SB, Nylund CM, Abbas MI et al. Thickened gastrointestinal wall findings on computed tomography in children: a reason for endoscopy? J. Pediatr. Gastroenterol. Nutr. 2013; 57: 305–10.

6. Iadicola D, De Marco P, Bonventre S et al. Bowel wall thickening: inquire or not inquire? Our guidelines. G. Chir. 2018; 39: 41–4.

7. Al-Khowaiter SS, Brahmania M, Kim E et al. Clinical and endoscopic Significance of bowel-wall thickening reported on abdominal computed tomographies in symptomatic patients with no history of gastrointestinal disease. Can. Assoc. Radiol. J. 2014; 65: 67–70.

8. Ooi CJ, Makharia GK, Hilmi I et al. Asia Pacific consensus statementson Crohn's disease. Part 1: definition, diagnosis, and epidemiology:(Asia Pacific Crohn's Disease Consensus–part 1).J. Gastroenterol. Hepatol. 2016; 31: 45–55.

9. Molodecky NA, Soon S, Rabi DM, Ghali WA, Ferris M, Chernoff G, et al. Increasing incidence and prevalence of the inflammatory bowel diseases with time, based on systematic review. Gastroenterology. 2012; 142: 46-54.

10. Thia KT, Loftus EV, Sandborn WJ, Yang S-K. An update on the epidemiologyof inflammatory bowel disease in Asia. Am.J. Gastroenterol. 2008; 103: 3167–82.

11. Amarapurkar DN, Patel ND, Rane PS. Diagnosis of Crohn's disease in India where tuberculosis is widely prevalent. World J. Gastroenterol.2008; 14: 741–6.
12. Makharia GK, Srivastava S, Das P et al. Clinical, endoscopic, and histological differentiations between Crohn's disease and intestinal tuberculosis. Am. J. Gastroenterol. 2010; 105: 642–51.
13. Afdhal NH, Yantiss RK. Case 25-2001: a 71-year-old man with gastric ulcers and ileocaecal thickening eight years after renal transplantation.N. Engl. J. Med. 2001; 345: 526–32.
14. Lee LH, MacLean AR, Falck VG, Gui X. Ileocaecal junction carcinoma: a clinicopathological study of 199 cases. Colorectal Dis. 2015; 17: O1–9.
15. Hoeffel C, Crema MD, Belkacem A et al. Multi-detector row CT: spectrum of diseases involving the ileocaecal area. Radiographics. 2006; 26: 1373–90.
16. Limsrivilai J, Shreiner AB, Pongpaibul A et al. Meta-analytic Bayesian model for differentiating intestinal tuberculosis from Crohn's disease.Am. J. Gastroenterol. 2017; 112: 415–27.
17. Zhai L, Zhao Y, Lin L et al. Non-Hodgkin's lymphoma involving the ileocaecal region: a single-institution analysis of 46 cases in a Chinese population. J. Clin. Gastroenterol. 2012; 46: 509–14.
18. Lewis JD, Deren JJ, Lichtenstein GR. Cancer risk in patients with inflammatory bowel disease. Gastroenterol. Clin. North Am. 1999; 28: 459–77.
19. Mohandas KM, Nagral A. Epidemiology of digestive tract cancers inIndia. II. Stomach, and gastrointestinal lymphomas. Indian J. Gastroenterol. 1998; 17: 24–7.
20. Singh DP, Sharma SC, Sandhu AP et al. Primary gastrointestinal lymphoma–disease spectrum and management: a 15-year review from north India. Indian J. Gastroenterol. 1997; 16: 88–90.

21. Macari M, Balthazar EJ. CT of bowel wall thickening: significance and pitfalls of interpretation. AJR Am. J. Roentgenol. 2001; 176: 1105-16.

22. Macari M, Megibow AJ, Balthazar EJ. A pattern approach to the abnormal small bowel: observations at MDCT and CT enterography. AJR Am. J. Roentgenol. 2007; 188:1344-55.

23. James S, Balfe DM, Lee JK, Picus D. Small-bowel disease: categorization by CT examination. AJR Am. J. Roentgenol. 1987;148: 863-8.

24. Karahan OI, Dodd GD, Chintapalli KN, Rhim H, Chopra S. Gastrointestinal wall thickening in patients with cirrhosis: frequency and patterns at contrast-enhanced CT. Radiology. 2000; 215: 103-7.

25. Desai RK, Tagliabue JR, Wegryn SA, Einstein DM. CT evaluation of wall thickening in the alimentary tract. Radiographics. 1991;11: 771-83.

26. Finkelstone L, Wolf EL, Stein MW. Etiology of small bowel thickening on computed tomography. Can. J. Gastroenterol. 2012; 26: 897–901.

27. Uzzaman MM, Alam A, Nair MS, Borgstein R, Meleagros L. Computedtomography findings of bowel wall thickening: its significanceand relationship to endoscopic abnormalities. Ann. R. Coll. Surg.Engl. 2012; 94: 23–7.

28. Gore RM, Balthazar EJ, Ghahremani GG, Miller FH. CT features of ulcerativecolitis and Crohn's disease. Am. J. Roentgenol. 1996; 167: 3–15

29. Balthazar EJ, Hulnick D, Megibow AJ, Opulencia JF. Computed tomography of intramural intestinal hemorrhage and bowel ischemia. J. Comput. Assist. Tomogr. 1987; 11: 67–72.

30. Balthazar EJ, Noordhoorn M, Megibow AJ, Gordon RB. CT of smallbowel lymphoma in immunocompetent patients and patients with

AIDS:comparison of findings. AJR Am. J. Roentgenol. 1997; 168: 675–80.

31. Horton KM, Abrams RA, Fishman EK. Spiral CT of colon cancer: imagingfeatures and role in management. Radiographics. 2000; 20: 419–30

32. Balthazar EJ. CT of the gastrointestinal tract: principles and interpretation.Am. J. Roentgenol. 1991; 156: 23–32.

33. Jacobs JE, Birnbaum BA. CT of inflammatory disease of the colon. Semin. Ultrasound CT MR. 1995; 16: 91–101.

34. Lane MJ, Katz DS, Mindelzun RE, Jeffrey RB Jr.Spontaneous intramural small bowel hemorrhage: importance of non-contrast CT. Clin Radiol1997; 52: 378–380

35. Buckley JA, Fishman EK. CT of small bowel neoplasms: spectrum of disease. Radio Graphics 1998; 18:379–392

36. Zhao X-S, Wang Z-T, Wu Z-Y et al. Differentiation of Crohn's disease from intestinal tuberculosis by clinical and CT enterographic models. Inflamm. Bowel Dis. 2014; 20: 916–25.

37. Sharma V, Singh H, Mandavdhare HS. Tubercular abdominal cocoon: systematic review of an uncommon form of tuberculosis. Surg. Infect. (Larchmt.). 2017; 18: 736–41.

38. Sharma R, Madhusudhan KS, Ahuja V. Intestinal tuberculosis versus Crohn's disease: clinical and radiological recommendations. Indian J. Radiol. Imaging. 2016; 26: 161–72.

39. Sugimoto E, Lörelius LE, Eriksson B, Oberg K. Midgut carcinoid tumours. CT appearance. Acta Radiol. 1995; 36: 367–71.

40. Levy AD, Remotti HE, Thompson WM, Sobin LH, Miettinen M. Gastrointestinal stromal tumors: radiologic featureswith pathologic correlation. Radiographics. 2003; 23: 283–304.

41. Nesher E, Schreiber L, Werbin N. Bauhin's ileocaecal valve syndrome-a rare cause for small-bowel obstruction: report of a case.Dis. Colon Rectum. 2006; 49: 527–9.

42. Thompson WM. Imaging and findings of lipomas of the gastrointestinal tract. AJR Am. J. Roentgenol. 2005; 184: 1163–71.
43. Sharma V, Mandavdhare HS, Lamoria S, Singh H, Kumar A.Serial C-reactive protein measurements in patients treated for suspected abdominal tuberculosis. Dig. Liver Dis. 2018; 50: 559–62.
44. Saito T, Toyoda H, Yamaguchi M et al. Ileocolonic lymphomas: a series of 16 cases. Endoscopy. 2005; 37: 466–9.
45. Pulimood AB, Peter S, Ramakrishna B et al. Segmental colonoscopic biopsies in the differentiation of ileocolic tuberculosis from Crohn's disease. J. Gastroenterol. Hepatol. 2005; 20: 688–96.
46. Fleming M, Ravula S, Tatishchev SF, Wang HL. Colorectal carcinoma:pathologic aspects. J. Gastrointest. Oncol. 2012; 3:153–73
47. Lundstedt C, Nyman R, Brismar J, et al. Imaging of tuberculosis. II. Abdominal manifestations in 112 patients. Acta Radiol. 1996; 37:489–95.
48. Bodily KD, Fletcher JG, Solem CA, et al. Crohn disease: mural attenuation and thickness at Contrast-enhanced CT enterography—correlation with endoscopic and histologic findings of inflammation.Radiology. 2006; 238: 505–16.
49. Wolff JH, Rubin A, Potter JD et al. Clinical significance of colonoscopic findings associated with colonic thickening on computed tomography: is colonoscopy warranted when thickening is detected?
J. Clin. Gastroenterol. 2008; 42: 472–5.
50. Scott R. Paulsen, James E. Huprich, Amy K. Hara. CT Enterography: Noninvasive Evaluation Of Crohn's Disease and Obscure Gastrointestinal Bleed. Radiologic Clinics Of North America. 2007;45:303– 315
51.Troppmann M, Lippert E, Hamer OW, Kirchner G, Endlicher E. Colonic bowel wall thickening: is there a need for endoscopic evaluation. Int. J. Colorectal Dis. 2012; 27: 601-4.

52. Lee JS, Cho JH, Kim KO, Lee SH, Jang BI. Clinical significance of the large intestinal wall thickening detected by abdominal computed tomography. Korean J. Gastroenterol. 2012;60:300–5.

53. Kalioubie M, Ali R. Abdominal CT enterography as an imaging tool for chronic diarrhea: Review of technique and diagnostic criteria. The Egyptian Journal of Radiology and Nuclear Medicine. 2015; 46: 275-286.

54. Megally HI, Seifeldein GS, Abbas NA, et al. The diagnostic role of MDCT enterography in small bowel lesions. The Egyptian Journal of Radiology and Nuclear Medicine. 2015; 46: 1-8.

55. Masselli G, Casciani E, Polettini E, Gualdi G. Comparison of MR enteroclysis with MR enterography and conventional enteroclysis in patients with Crohn's disease. Eur Radiol. 2008; 18: 438-47.

56. Kedia S, Sharma R, Nagi B, Mouli VP, Aananthakrishnan A, Dhingra R, et al. Computerized tomography-based predictive model for differentiation of Crohn's disease from intestinal tuberculosis. Indian J Gastroenterol. 2015; 34:135-43.

57. Gale HI, Sharatz SM, Taphey M, et al. Comparison of CT enterography and MR enterography imaging features of active Crohn disease in children and adolescents. Pediatric Radiology.2017; 47:1321-8.

58. Varma RU, Rajpal KL, Bite NR, et al. Utility of CT enterography in the evaluation of small bowel pathologies. International Journal of Advances in Medicine. 2017; 4:1328

59. Abd El Rasool RM, Amine SK, Nasr MA, et al. Role of CT Enterography in the Diagnosis of Crohn's Disease. The Egyptian Journal of Hospital Medicine. 2018; 72: 4126-33

60. Chamail A, Aggarwal N, Makhaik S, et al. CT Enterography for diagnosis of Small Bowel Disorders.

61. Misra RN, Bajaj S. Role of CT enterography in evaluation of small bowel disorders. Int J Res Med Sci. 2019; 7: 537-43.

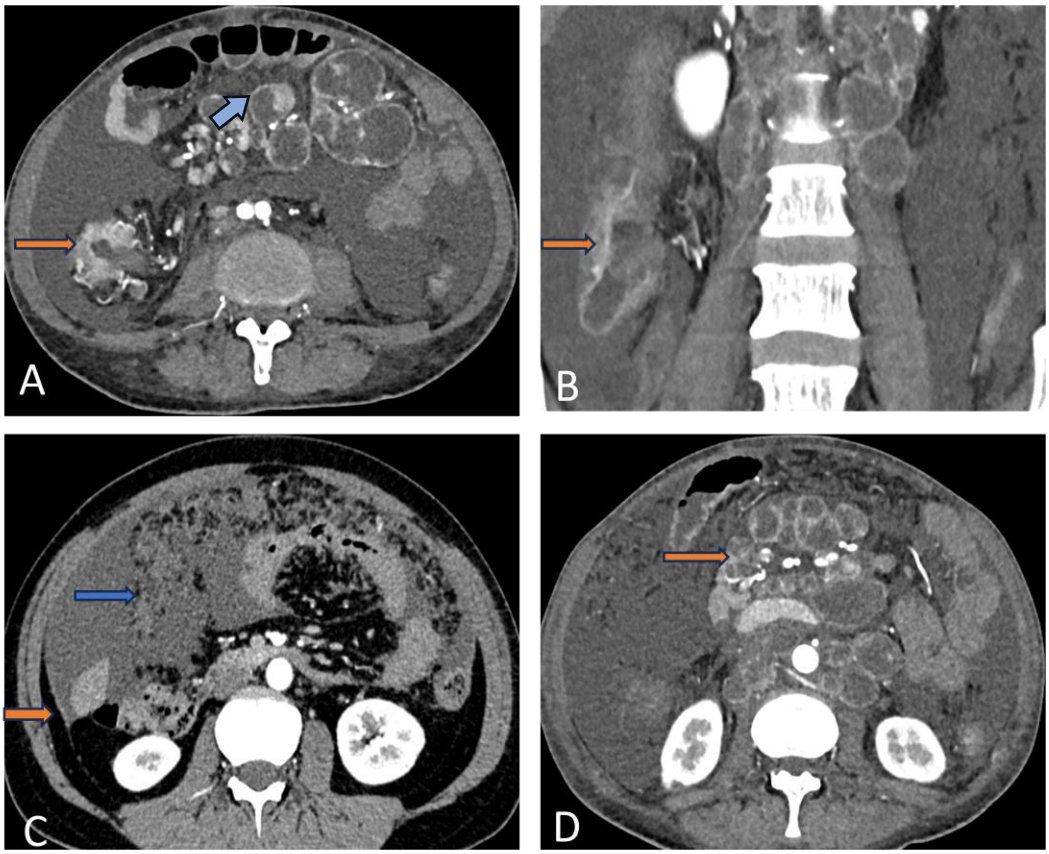
62. Tapasvi C, Prajapati N, Madhok R, Gupta AK, Taneja V, Aggarwal A, et al. Evaluation of Bowel Wall Thickening by Computed Tomography to Differentiate Benign from Malignant lesions. 2014; 8: RC09-RC12

63. Ilangovan R, Burling D, George A, et al. CT enterography: review of technique and practical tips. The British journal of radiology. 2012; 85: 876-86.

64. Fernandes T, Oliveira MI, Castro R, et al. Bowel wall thickening at CT: simplifying the diagnosis. Insights into imaging. 2014; 5:195-208.

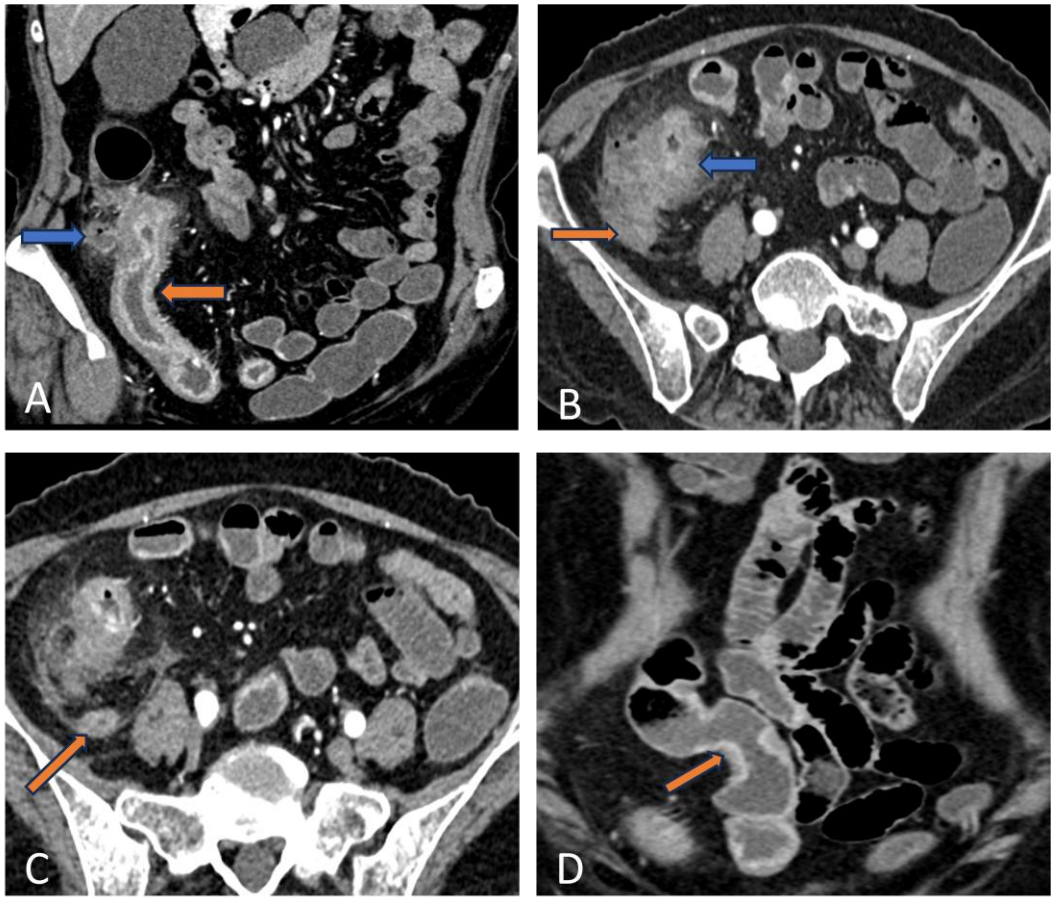
65. Mohamed AM, Amin SK, El-Shinnawy MA, et al. Role of CT enterography in assessment of Crohn's disease activity: Correlation with histopathologic diagnosis. The Egyptian Journal of Radiology and Nuclear Medicine. 2012; 43 :353-9.

CASES



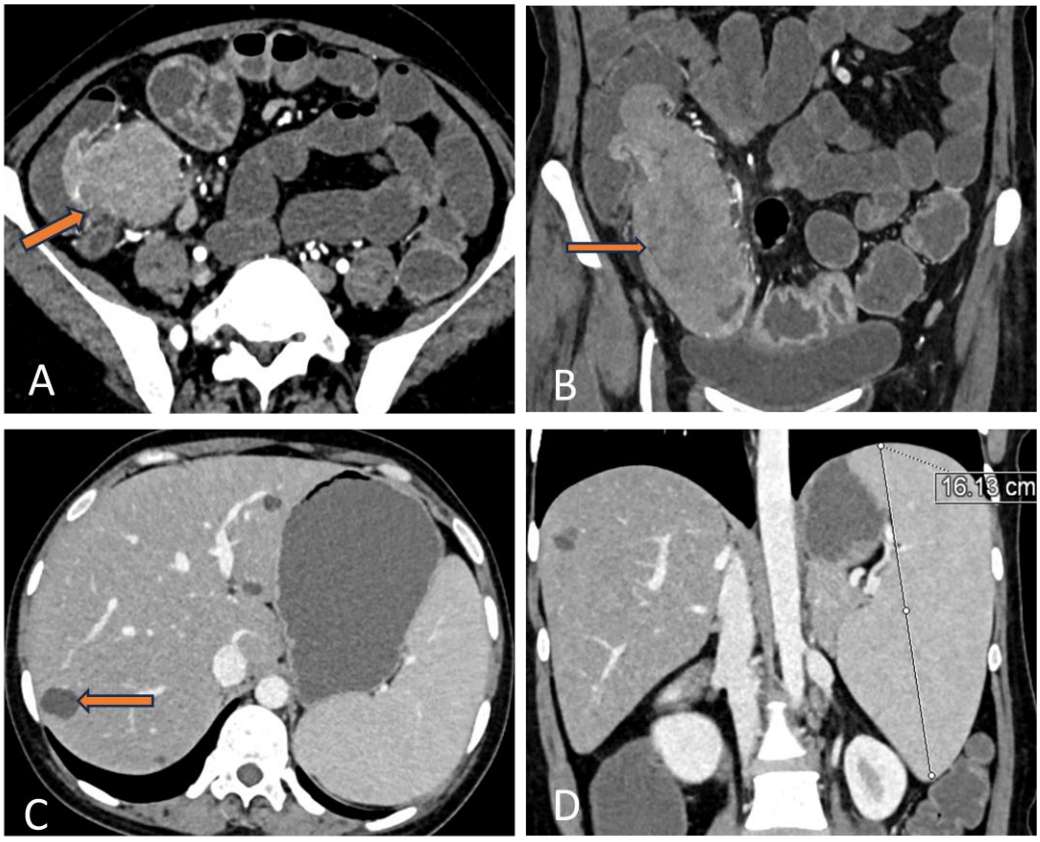
Picture 1: 47-year-old male with history of constipation. (A) and (B) Axial and Coronal contrast-enhanced CT images which show circumferential asymmetrical wall thickening of caecum and proximal ascending colon.

(C) Axial CECT image shows omental stranding (blue arrow) and thickening of parietal peritoneum (orange arrow).(D) Axial image shows necrotic conglomerated lymph nodes at root of mesentery. The overall findings favored the diagnosis of ileocaecal tuberculosis and was proven histopathologically.

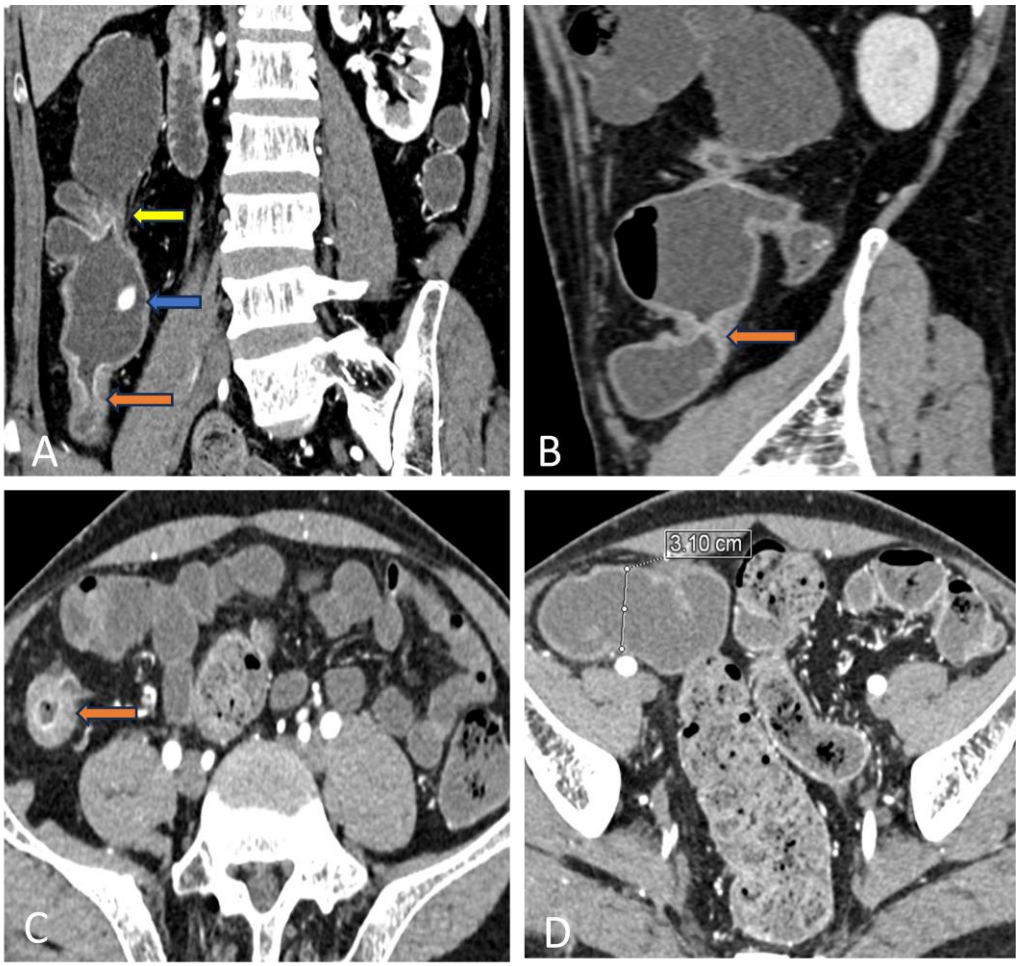


Picture 2: A 63-year-old female with history of pain abdomen and weight loss.(A)and (B) Coronal and Axial CECT images show long segment circumferential wall thickening of terminal ileum, IC junction and caecum with mucosal hyperenhancement and mural stratification. A small air containing collection is seen adjacent to terminal ileum near IC junction- secondary to microperforation / sinus tract.(C) Axial CECT image shows adjacent fat stranding and thick walled appendix (secondary appendicitis)

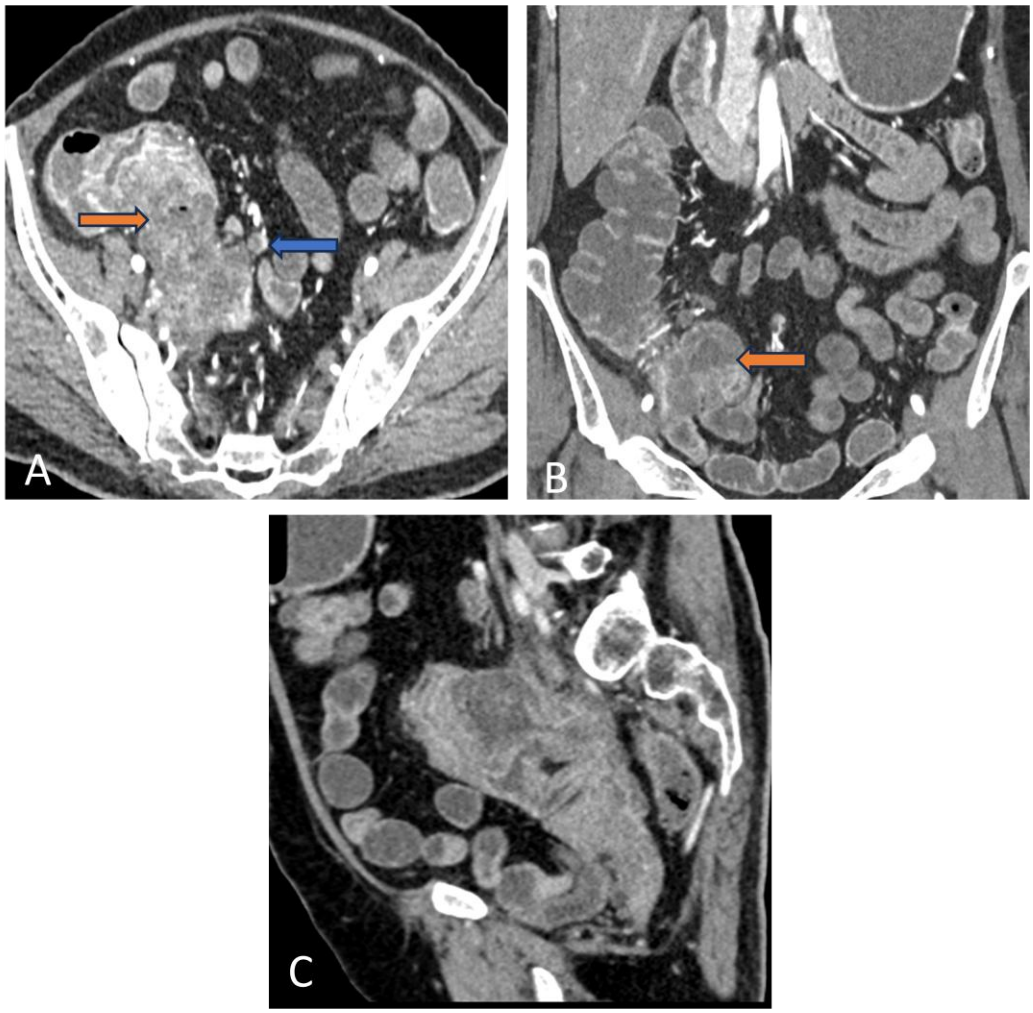
(D) Coronal CECT image shows skip segment showing wall thickening and mural hyperenhancement seen in terminal ileum. Overall findings were suggestive of Crohn's disease which was confirmed on histopathology.



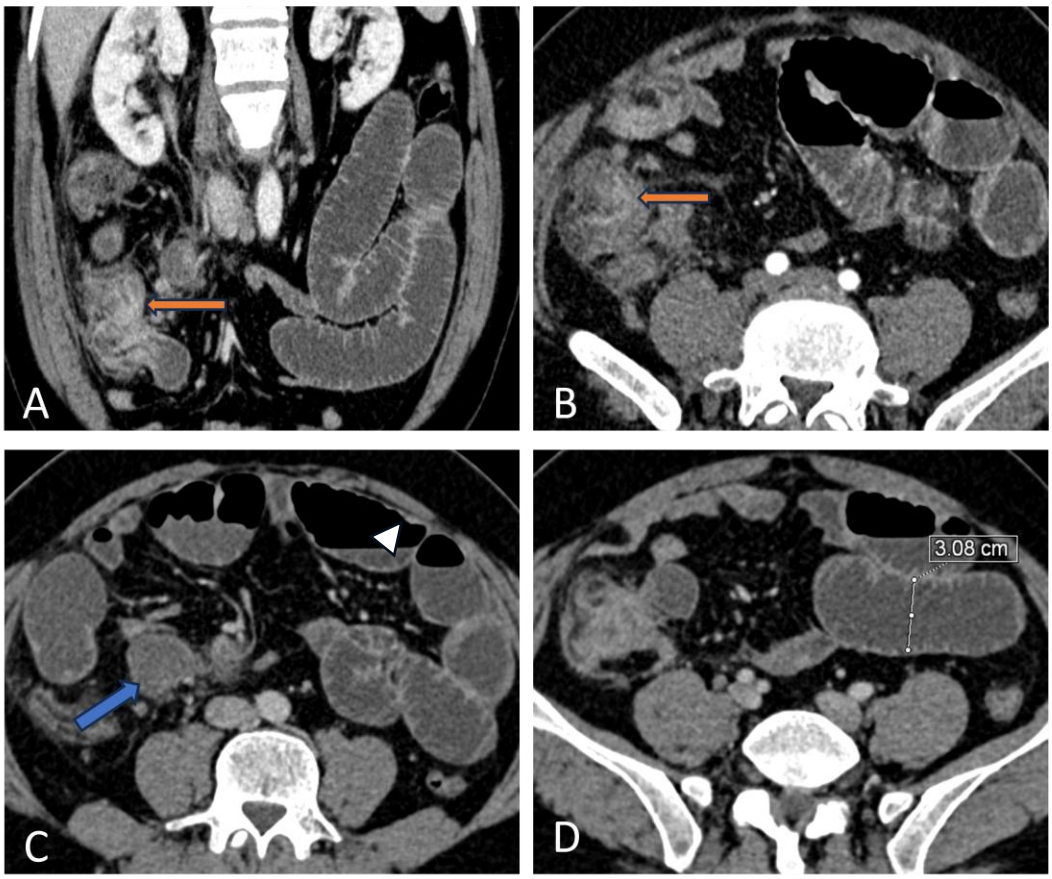
Picture 3: 38 year old female with history of anemia and weight loss. (A) And (B) Axial and Coronal CECT images show diffuse circumferential homogenously enhancing wall thickening involving terminal ileum and IC junction causing distension of affected loop and marked luminal narrowing. (C) Axial CECT image shows multiple hypodense liver lesions. (D) Coronal CECT image shows splenomegaly. Overall findings favored Lymphoma which was confirmed on histopathology.



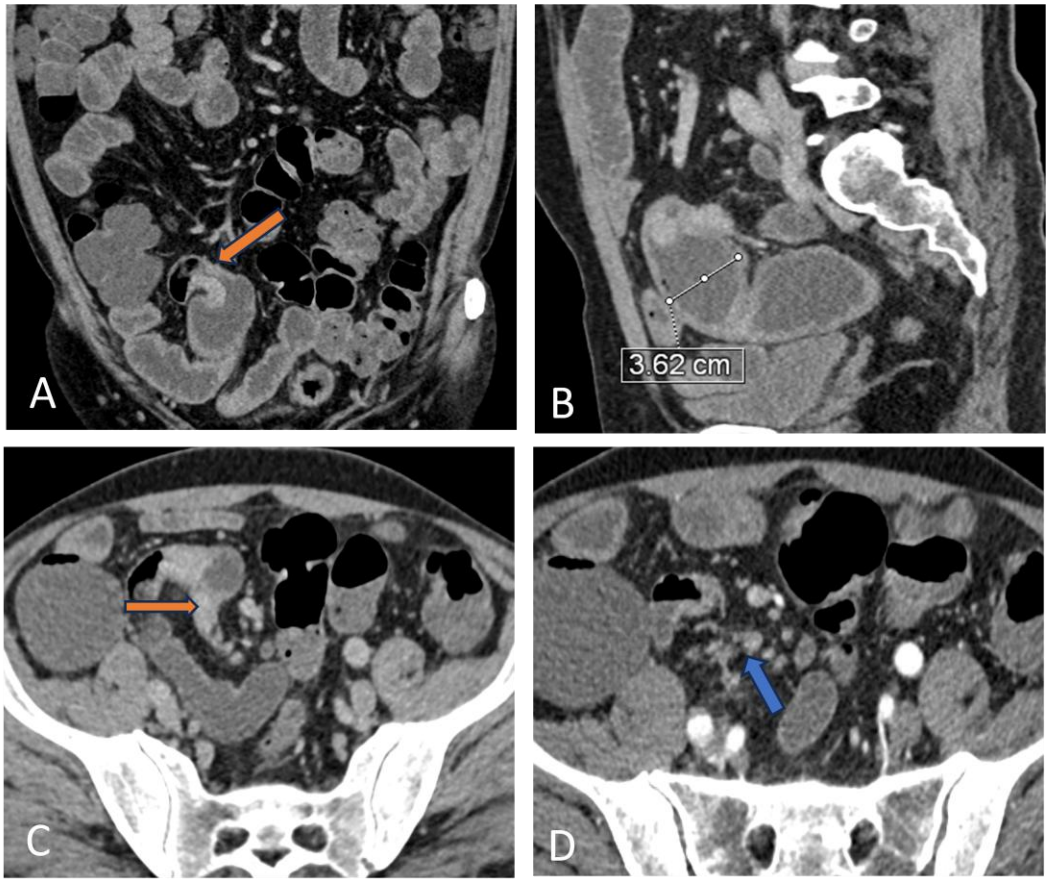
Picture 4: 52-year-old male with history of pain abdomen.(A) And (B) Coronal and Sagittal CECT images show short segment of circumferential wall thickening with mural hyperenhancement involving distal ileal loop (orange arrow). There is focal dilatation of terminal ileum with enterolith formation (blue arrow). There is a tight stricture at the junction of caecum and ascending colon (yellow arrow). (C) And (D) Axial CECT images show circumferential wall thickening of distal ileal loop with proximal dilatation of ileal loops. Overall findings favored Ileocaecal tuberculosis which was confirmed histopathologically.



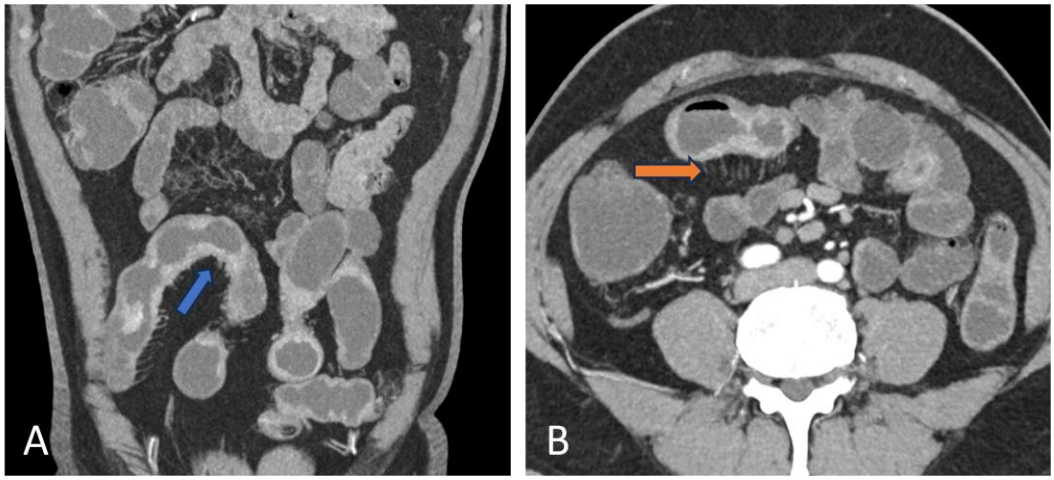
Picture 5: 52-year-old female with history of fever and pain abdomen. (A), (B) and (C) Axial, coronal and sagittal CECT images show circumferential mass like wall thickening of caecum. Distal ileal loops and rectosigmoid colon are closely adherent to the mass. The mass is abutting pelvic peritoneum and right adnexa. Multiple subcentimetric necrotic lymph nodes are seen in ileocolic mesentery (blue arrow). Diagnostic possibilities included malignancy and amoebic colitis. Histopathology was suggestive of mucinous adenocarcinoma of caecum.



Picture 6: 47 year old male with history of obstipation. (A) and (B) Coronal and Axial CECT images show circumferential asymmetrical wall thickening of distal ileum, IC junction and caecum. (C) Axial CECT image shows necrotic lymph nodes in ileocaecal mesentery. (D) Axial CECT image shows proximal dilated small gut loops. Overall findings favored ileocaecal tuberculosis. However, histopathology was suggestive of signet ring cell carcinoma of colon.



Picture 7: 65-year-old male with history of pain abdomen. (A) Coronal CECT image shows a short segment of circumferential wall thickening with mural hyperenhancement involving distal ileal loop. (B) sagittal CECT image shows focal prominence of proximal ileal loops. (C) Axial image shows direct nodular extension to adjacent small bowel mesentery. (D) Axial image shows few subcentimetric lymph nodes in ileocolic mesentery. Overall imaging findings favored malignant etiology. Histopathology was suggestive of Neuroendocrine tumor.



Picture 8: 65-year-old male with history of chronic diarrhoea. (A) Coronal CECT image shows asymmetrical wall thickening with mural hyperenhancement involving distal ileal loops with shortening of mesenteric border and surrounding fibrofatty proliferation. (B) Axial CECT image shows prominent vasa recta in surrounding mesentery. Overall findings favored Crohn's disease which was confirmed on histopathology.

KEY TO MASTER CHART

M	MALE
F	FEMALE
N	NORMAL
ND	NOT DONE
+	PRESENT
-	ABSENT
LN	LYMPH NODE
INDETER	INDETERMINATE
HPE	HISTOPATHOLOGY

																			CECT FINDINGS											
					CHIEF COMPLAINTS					LAB INVESTIGATIONS									INTESTINAL INVOLVEMENT		LENGTH OF INVOLVEMENT			REGION INVOLVED					DEGREE OF THICKENING	
S.NO	MRD NO	AGE	Age group	SEX	FEVER	PAIN ABDOMEN	VOMITING	ALTERED BOWEL HABITS	LOSS OF WT/ APPETITE	TLC	HB	SGOT	SGPT	Total BR	S.CR	ESR	MONTOUX (if done)	CXRAY FINDINGS (if done)	FOCAL	MULTIFOCAL	FOCAL	SEGMENTAL	DIFFUSE	ILEUM	IC JUNC	CECUM	APPENDIX	COLON	< 1 cm	>1 cm
1	1391041	74	6	F	-	+	-	-	+	12.9	11	45	42	0.2	0.64	10	Negative	ND	-	+	-	+	-	+	+	+	-	+	-	+
2	1514211	65	6	M	-	-	-	+	+	8.4	11.4	30	35	0.4	0.55	25	Negative	ND	-	+	+	-	-	+	+	-	-	-	+	-
3	1382973	27	2	M	-	+	-	+	+	7.4	12	18	26	0.5	0.5	15	Negative	ND	+	-	-	+	-	+	+	+	-	-	+	-
4	1542380	40	3	M	-	+	-	+	-	5.7	12.5	25	30	0.4	0.6	50	ND	N	+	-	+	-	-	+	+	+	-	-	-	+
5	1513795	52	5	F	+	+	-	-	+	6.2	10.5	32	24	0.2	0.7	35	ND	N	+	-	-	+	-	+	+	+	+	-	-	+
6	1395740	47	4	M	+	+	-	-	-	9	12.5	25	20	0.3	0.5	35	ND	N	-	+	-	+	-	+	+	+	-	-	+	-
7	1443262	47	4	M	-	+	-	+	-	4.2	12.7	34	27	0.5	0.4	72	Positive	ND	+	-	-	+	-	-	-	+	-	+	-	+
8	1441155	23	2	F	+	+	-	-	+	8.9	10.6	24	40	0.3	0.8	75	Positive	Abnormal	+	-	+	-	-	+	-	-	-	-	+	-
9	1301792	63	6	F	-	+	-	-	+	7.3	11.5	12	9	0.18	0.1	24	ND	N	-	+	-	+	-	+	+	+	+	+	-	+
10	1455255	38	3	F	-	+	-	-	-	6	11	28	25	0.5	0.53	15	ND	N	+	-	-	+	-	+	+	-	-	-	-	+
11	1506281	65	6	M	-	+	-	-	+	7	10.5	25	30	0.3	0.9	32	Positive	ND	+	-	+	-	-	+	-	-	-	-	+	-
12	1690922	48	4	F	-	+	+	+	-	10.4	7.4	26	8	0.2	0.7	18	ND	ND	+	-	-	+	-	+	+	+	-	+	-	+
13	1301774	36	3	F	-	+	-	-	-	6.8	11	32	28	0.4	0.5	62	Positive	ND	-	+	+	-	-	+	+	+	-	-	-	+
14	1392009	70	6	F	-	+	-	+	-	8	10.2	40	35	0.7	0.8	50	ND	N	-	+	-	+	-	+	+	-	-	-	+	-
15	1440211	39	3	F	+	+	-	+	-	4.6	12.5	12	20	0.3	0.5	36	Positive	N	+	-	-	+	-	+	+	+	-	+	-	+
16	1217907	24	2	F	+	+	-	+	+	5.4	12.7	25	22	0.6	0.4	50	Positive	ND	-	+	-	+	-	+	+	+	+	+	+	-
17	1409858	9	1	F	-	+	-	-	-	6.2	10.2	23	30	0.2	0.3	40	Negative	N	+	-	-	+	-	+	+	-	-	-	+	-
18	1537959	47	4	M	-	+	-	+	-	23.8	13.2	35	37	0.6	0.8	70	Negative	N	-	+	-	-	+	+	-	-	-	-	+	-
19	1567352	47	4	M	-	+	-	+	-	7.4	11.7	25	28	0.4	0.5	20	Negative	Abnormal	+	-	-	+	-	-	+	+	-	+	+	-
20	1600196	47	4	M	-	+	+	+	-	8.2	12.2	34	30	0.7	0.4	15	ND	N	+	-	-	+	-	+	+	+	-	+	-	+
21	1587140	62	6	M	-	+	+	-	-	9.5	11.1	12	15	0.2	0.5	13	Negative	N	+	-	-	+	-	+	+	-	-	-	+	-
22	1361351	49	4	M	-	+	-	+	-	5.7	13.1	32	35	0.5	0.7	18	Negative	ND	+	-	-	+	-	+	-	-	-	-	+	-
23	1521425	60	5	F	-	+	-	-	-	7.9	10.8	28	25	0.1	0.8	38	ND	N	+	-	+	-	-	-	+	+	-	+	-	+
24	1395561	49	4	F	-	+	-	-	-	22.9	10.4	13	17	0.2	0.8	115	Positive	Abnormal	-	+	-	+	-	+	+	-	-	+	+	-
25	1605547	45	4	M	-	+	-	+	-	8.8	12.9	29	28	0.5	0.6	10	Positive	N	+	-	+	-	-	+	+	+	-	-	-	+
26	1632802	12	1	M	+	-	+	-	-	5.6	11.8	25	30	0.3	0.5	15	ND	N	+	-	+	-	-	+	+	-	-	-	+	-
27	1549882	44	4	F	-	+	+	+	-	6.8	13.2	21	35	0.4	0.9	40	ND	N	-	+	+	-	-	+	+	-	-	+	-	+
28	890331	29	2	M	-	+	-	-	-	12.4	12	35	25	0.2	0.6	11	ND	N	+	-	+	-	-	-	+	+	-	+	+	-
29	1630378	52	5	M	-	+	-	+	-	7.4	12.5	39	36	0.4	0.7	17	Positive	Abnormal	+	-	+	-	-	+	+	+	-	+	+	-
30	1643276	49	4	M	+	+	-	-	+	8.5	13.7	40	45	0.6	0.8	50	Positive	N	+	-	-	+	-	-	+	+	-	-	-	+

	CECT FINDINGS																							
	BOWEL WALL THICKENING		PATTERN OF ENHANCEMENT			LYMPH NODE INVOLVEMENT (if present)			LN SIZE		ILEOCAECAL VALVE				ILEOCAECAL ANGLE							PERITONEAL THICKENING		
S.NO	SYMMETRICAL	ASYMMETRICAL	HETEROGENOUS	STRATIFIED	HOMOGENOUS	NECROSIS	CALCIFICATION	HOMOGENOUS ENH	<1 cm	>1 cm	NORMAL	CONTRACTED	PATULOUS	INDETER.	NORMAL	OBTUSE	RIGHT	MESENTERIC FAT STR.	ABSCESS & SINUS TRACTS	FAT PROLIFERATION	SOLID ORGAN ABNORMALITIES	ABSENT	SMOOTH	IRREGULAR/ NODULAR
1	-	+	+	-	-	-	-	+	-	+	-	-	+	-	-	+	-	+	+	-	-	-	-	+
2	-	+	-	-	+	-	-	+	-	+	-	-	+	-	+	-	-	+	-	+	-	+	-	-
3	+	-	-	+	-	-	-	+	-	+	+	-	-	-	+	-	-	+	-	+	-	+	-	-
4	-	+	+	-	-	+	-	-	-	+	-	-	-	+	+	-	-	+	-	-	+	-	-	+
5	-	+	+	-	-	+	-	-	+	-	-	-	-	+	+	-	-	+	+	+	-	-	-	+
6	+	-	-	-	+	-	-	+	+	-	-	+	-	-	+	-	-	+	-	-	-	+	-	-
7	-	+	+	-	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	-	+	-	+	-
8	+	-	-	-	+	+	+	-	+	-	+	-	-	-	+	-	-	+	-	-	-	-	+	-
9	-	+	-	+	-	-	-	+	-	+	-	-	-	-	-	+	-	+	+	+	-	+	-	-
10	-	+	-	-	+	-	-	+	-	+	+	-	-	-	+	-	-	+	-	-	+	+	-	-
11	-	+	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-
12	-	-	-	-	+	+	-	+	-	+	-	+	-	-	-	+	-	+	-	-	-	+	-	-
13	+	-	+	-	-	+	-	-	+	-	-	-	+	-	-	+	-	+	-	-	-	+	-	-
14	+	-	-	+	-	-	-	+	+	-	-	+	-	-	-	-	+	+	-	+	-	+	-	-
15	-	+	+	-	-	-	-	+	+	-	+	-	-	-	+	-	-	+	-	-	-	-	+	-
16	-	+	+	-	-	+	+	-	-	+	-	-	+	-	-	+	-	+	-	-	-	-	+	-
17	-	+	-	-	+	-	-	+	-	+	-	-	+	-	-	-	+	+	-	+	-	+	-	-
18	+	-	-	+	-	-	-	+	+	-	+	-	-	-	+	-	-	-	-	+	-	+	-	-
19	-	+	+	-	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	-	+	-	-	+
20	+	-	-	-	+	-	-	+	+	-	-	-	+	-	+	-	-	+	-	-	-	+	-	-
21	-	+	-	-	+	-	-	-	-		+	-	-	-	+	-	-	-	-	-	-	+	-	-
22	-	+	-	-	+	-	-	+	+	-	+	-	-	-	+	-	-	+	-	+	-	+	-	-
23	+	-	+	-	-	+	-	-	-	+	-	+	-	-	+	-	-	+	-	-	-	+	-	-
24	-	+	+	-	-	+	-	-	-	+	-	-	+	-	+	-	-	+	-	-	-	+	-	-
25	-	+	+	-	-	-	-	+	+	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-
26	+	-	-	-	+	-	-	+	+	-	+	-	-	-	+	-	-	-	-	-	-	+	-	-
27	-	+	+	-	-	-	-	+	+	-	-	-	+	-	-	+	-	+	-	+	-	+	-	-
28	+	-	-	-	+	-	-	+	+	-	-	+	-	-	-	+	-	+	-	+	-	+	-	-
29	-	+	-	+	-	-	-	-	-	-	-	-	-	+	-	+	-	+	-	+	-	+	-	-
30	-	+	+	-	-	-	-	+	+	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-

			ENDOSCOPY FINDINGS (if done)							HISTOPATHOLOGY FINDINGS (if done)						DIAGNOSIS					
				ULCERS											IF MALIGNANT						
S.NO	ASCITIS	OMENTAL DISEASE	NODULARITY	DEEP	APHTHOUS	FISSURES	FISTULA	COBBLESTONE APPEARANCE	STRICTURE	ULCERATION	CRYPTITIS	LYMPHOID AGGREGATES	TYPE OF INFILTRATE	GRANULOMA	HISTOLOGICAL TYPE	CECT DIAGNOSIS	COLONOSCOPIC DIAGNOSIS	HPE DIAGNOSIS	FINAL DIAGNOSIS	MANAGEMENT	CLINICAL FOLLOW UP
1	-	+	-	-	-	-	-	-	+	-	-	-	malignant	-	Adenocarcinoma	Malignant	Malignant	Adenocarcinoma	adenocarcinoma colon	Surgical	stable
2	-	-	+	+	-	-	-	-	-	+	+	-	Acute and chronic	-	-	IBD	Ileitis	IBD	Inflammatory bowel disease	Conservative	stable
3	-	-	-	+	-	-	-	-	-	-	-	-	Chronic	-	-	IBD	Non specific	Non specific	Inflammatory bowel disease	Conservative	stable
4	+	+	-	-	-	-	-	-	-	-	-	-	malignant	-	Adenocarcinoma	Tuberculosis	ND	Adenocarcinoma	adenocarcinoma colon	Conservative	stable
5	-	-	-	-	-	-	-	-	-	-	-	-	malignant cells	-	Adenocarcinoma	Malignant/Amoebic colitis	ND	Adenocarcinoma	adenocarcinoma colon	Surgical	stable
6	-	-	-	+	-	-	-	-	-	+	+	-	Acute and chronic	-	-	Tuberculosis/ IBD	Non specific	infective colitis	infective colitis	Conservative	stable
7	+	+	-	-	-	-	-	-	-	-	+	-	Acute and chronic	+	-	Tuberculosis/Lymphoma	ND	Tuberculosis	Abdominal tuberculosis	Conservative	stable
8	+	+	+	+	+	-	-	-	-	+	-	+	Chronic	-	-	Tuberculosis	Non specific	Non specific	Abdominal tuberculosis	Conservative	stable
9	-	-	+	+	-	-	-	-	+	+	+	-	Chronic	-	-	IBD	IBD	IBD	Inflammatory bowel disease	Conservative	stable
10	-	-	+	+	+	-	-	-	+	+	-	-	acute	-	-	Lymphoma	Non specific	Lymphoma	Non hodgkin lymphoma	Conservative	stable
11	-	-	-	-	-	-	-	-	-	-	-	+	malignant	-	-	Malignant/IBD	Non specific	Neuroendocrine	Neuroendocrine tumor	Surgical	stable
12	+	+	-	-	-	-	-	-	-	-	-	-	malignant	-	lymphoma	Lymphoma	Malignant	Lymphoma	Non hodgkin lymphoma	Conservative	stable
13	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-	Tuberculosis	ND	ND	Abdominal tuberculosis	Conservative	stable
14	-	-	+	-	-	-	-	-	+	+	+	-	Acute and chronic	-	-	IBD	Non specific	infective colitis	infective colitis	Conservative	stable
15	+	+	-	-	+	-	-	-	-	+	+	+	Acute and chronic	-	-	Tuberculosis	Ileitis	Tuberculosis	Abdominal tuberculosis	Conservative	stable
16	-	-	-	-	-	-	-	-	-	-	-	-	ND	-	-	Tuberculosis	ND	ND	Abdominal tuberculosis	Conservative	stable
17	-	-	-	+	-	-	-	-	-	+	+	+	Acute and chronic	-	-	IBD	Non specific	infective colitis	Inflammatory bowel disease	Conservative	stable
18	-	-	-	+	-	-	-	-	-	+	-	+	Chronic	-	-	IBD	Non specific	infective colitis	Inflammatory bowel disease	Conservative	stable
19	-	+	-	-	-	-	-	-	+	+	-	-	malignant	-	-	Tuberculosis	Malignant	Malignant	Signet ring cell carcinoma	Surgical	stable
20	-	-	-	+	-	-	-	-	-	+	-	-	Acute and chronic	-	-	Malignant/IBD	Non specific	Ischemic colitis	ischemic colitis	Surgical	stable
21	+	-	-	+	-	-	-	-	-	+	+	-	Acute and chronic	-	-	IBD	ND	IBD	Inflammatory bowel disease	Surgical	Expired
22	-	-	-	-	+	-	-	-	+	+	-	-	Chronic	-	-	IBD	Stricture	Non specific	Inflammatory bowel disease	Conservative	stable
23	-	-	-	+	-	-	-	-	-	+	-	-	malignant	-	Adenocarcinoma	Tuberculosis	Non specific	Malignant	adenocarcinoma colon	Surgical	Expired
24	+	-	-	-	+	-	-	-	-	-	-	-	Acute and chronic	-	-	Tuberculosis	Non specific	Non specific	Abdominal tuberculosis	Conservative	stable
25	-	-	-	+	-	-	-	-	+	+	+	+	Acute and chronic	+	-	Tuberculosis/IBD	Stricture	Tuberculosis	Abdominal tuberculosis	Conservative	stable
26	-	-	+	-	-	-	-	-	-	+	+	+	Acute and chronic	-	-	Tuberculosis/IBD	Non specific	infective colitis	infective colitis	Conservative	stable
27	-	-	-	+	-	-	-	-	+	+	+	-	Acute and chronic	-	-	IBD	IBD	IBD	Inflammatory bowel disease	Conservative	stable
28	-	-	-	+	-	-	-	-	+	+	-	+	Acute and chronic	-	-	IBD	Stricture	Non specific	Inflammatory bowel disease	Conservative	stable
29	-	-	-	-	-	-	-	-	+	+	-	-	Acute and chronic	-	-	Tuberculosis	Stricture	Non specific	Abdominal tuberculosis	Conservative	stable
30	+	-	-	-	-	-	-	-	+	+	+	+	Acute and chronic	-	-	Malignant	Stricture	Tuberculosis	Abdominal tuberculosis	Surgical	stable

Baba Farid University
of Health Sciences
Sadiq Road
Faridkot-151 203 (Pb). INDIA.
Phone : 01639-256232,256236
Tele/Fax : 01639-256235
Email – Thesisbfuhs@gmail.com

(60)

No. BFUHS/2K23p-TH/ 45 Date 1/1/24

The Principal
Dayanand Medical College & Hospital
Ludhiana

Subject:: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 25.09.2023 has approved the plan of thesis of **Sanchi Baghla**, a student of your college for **MD Radio-diagnosis** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Role o mdct abdomen in evaluation of ileocaecal pathologies .

Supervisor
Dr. Kamini Gupta
Professor
Dept. of Radiodiagnosis

Co-Supervisor:-
Dr. Kavita Saggar
Prof. & Head
Dept. of Radiodiagnosis

The student may submit the thesis in triplicate alongwith the plan in triplicate also, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

RADIODIAGNOSIS

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

AUGUST, 2022

DR. SANCHI BAGHLA

DEPARTMENT OF RADIODIAGNOSIS
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	**ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES**
For the degree of	MD Radiodiagnosis
Name of the candidate	Dr. Sanchi Baghla
Supervisor	Dr. Kamini Gupta, Professor, Department of Radiodiagnosis, DMCH, Ludhiana
Co-supervisor(s)	Dr. Kavita Saggar, Professor and Head of Department, DMCH, Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction:- Multidetector computed tomography is an important tool in detection and characterization of bowel abnormalities and allows assessment of mural and extraluminal abnormalities. The various causes of bowel wall abnormalities include neoplastic, infectious, inflammatory and ischemic conditions. In some cases, mural thickening may be non specific or simply due to technical reasons like inadequate bowel distension.

Aim of study:

1) To characterize the ileocaecal pathologies on MDCT abdomen.

2)To correlate MDCT findings with clinical, endoscopy findings and histopathology wherever possible.

Materials and Methods: This study will be conducted over a period of one and half year and will include patients referred for MDCT abdomen to the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana and found to have ileocaecal pathologies.

Clinical Significance: To characterize and predict the possible etiology of ileocaecal abnormalities in patients undergoing MDCT abdomen so as to diagnose the underlying disease and contribute to timely management of patients.

(Signature) Candidate	(Signature) Co-supervisor	(Signature) Supervisor	(Signature) Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"ROLE OF MDCT ABDOMEN IN EVALUATION OF ILECAECAL PATHOLOGIES"** exist in the Department of Radiodiagnosis, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate herself under our supervision and guidance.

Supervisor

Dr. Kamini Gupta
Professor
Department of Radiodiagnosis
DMCH, Ludhiana

Co-Supervisor

Dr. Kavita Saggar
Professor and Head
Department of Radiodiagnosis
DMCH, Ludhiana

Head of the Department

Dr. Kavita Saggar
Professor & Head
Department of Radiodiagnosis
DMCH, Ludhiana

Place : _____

Date : _____

APPROVAL PROFORMA
BY RESEARCH & ETHICAL COMMITTEE
DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA

Name of candidate	DR. SANCHI BAGHLA
Department	RADIODIAGNOSIS
Topic of Thesis	ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES
Likely date of appearing in PG examination	May/Juness, 2024
Date of enrollment	February 28, 2022
Name of Head of Department	Dr. Kavita Saggar
1) Supervisor **2) Co-Supervisor(s)**	Dr. Kamini Gupta Dr. Kavita Saggar
Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
Dr. Harpreet Kaur (Professor & Head, Pathology)	Mr. R K Sharma (Legal Expert)
Dr. Jaspal Singh (Professor & Head, Surgery)	Dr. Ramit Mahajan (Associate Professor, Gastroenterology)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)	Dr. Sandeep Kaushal (Dean Academics & Professor & Head, Pharmacology)
Dr. Gurpreet S Wander (Vice Principal)	Dr. Gurpreet S Wander (Vice Principal & Professor & Head, Cardiology)
	Dr. Gagandeep Singh (Secretary, Ethics Committee Professor & Head, Neurology)

Approved: Yes / ~~No~~

Dr. Sandeep Puri
Chairperson
Research Committee

Chairperson
Research Committee

Approved: Yes / ~~No~~

Prof. Arvind Malhotra
Chairperson
Ethics Committee

Chairperson
Ethics Committee

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

1	NAME OF THE CANDIDATE AND ADDRESS	DR. SANCHI BAGHLA
2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA
3	COURSE OF STUDY AND SUBJECT	MD RADIODIAGNOSIS
4	DATE OF ADMISSION OF COURSE	28 FEBRUARY 2022
5	TITLE OF THE TOPIC	Role of MDCT abdomen in evaluation of Ileocaecal pathologies

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Small bowel imaging is often tedious task because of its length, tortuosity and the undulating bowel. However, its imaging has been improvised with upcoming advancements. An ideal imaging of the small bowel should provide information ranging from the lumen, mucosa, wall, extra-enteric involvement and also information about the extent and severity of the disease process. Other aspects like the invasive nature, usage of ionizing radiation/intravenous contrast, cost and accessibility could also affect the prevalence of usage of an imaging modality. Traditional small bowel follow through examinations are nowadays being replaced by cross sectional imaging.

Though fluoroscopic studies like BMFT ensures luminal distension hence making it ideal for viewing the enteric mucosa and partial strictures, the overlapping bowel reduces the sensitivity of the test. Even capsule endoscopy has superior mucosal visualization and abilities to obtain biopsies for assessing histologically, but is often limited by its inability to view extra enteric structures, subjective interpretation, difficulty in tumor localization and its usage in patients having strictures due to its chances of getting lodged within. CT and MR enteroclysis also works on the principles of luminal distension with enteric contrast material through a nasoenteric tube followed by spatial and temporal viewing of the bowel. It is an ideal modality for detecting strictures. However; the semi-invasiveness causing patient discomfort and expert operator dependency often restricts their widespread use.

Multidetector computed tomography has become an important tool in detection and characterization of bowel abnormalities and allows assessment of mural and extraluminal abnormalities.[1,2] Thickening of bowel wall is a frequent finding in patients with gastrointestinal symptoms and suggests possible bowel disease. The normal small bowel wall thickness on CT varies depending on bowel distension. Wall thickness in a well distended gut loop measure upto 3 mm, and can be upto 5 mm when lumen is collapsed.[3-5]

The various causes of bowel wall thickening include neoplastic, infectious, inflammatory, ischemic conditions or it can be nonspecific or secondary to systemic reasons. In some cases, mural thickening may be due to technical reasons like inadequate bowel distension. CT diagnosis in a bowel pathology depends upon length of involved segment, degree of thickening, symmetrical vs asymmetrical involvement, pattern of attenuation and enhancement, peri-intestinal abnormalities like lymphadenopathy, abscess and sinus tracts, mesenteric fat stranding, fat proliferation and associated solid organ abnormalities.[1-6]

When thickening of small or large bowel wall is identified on CT, the first step is to assess extent of bowel involved. Distinction should be made between focal (less than 5 cm of extension), segmental (6-40 cm) or diffuse (>40 cm) involvement. This is an important step in differentiating between benign and malignant causes of bowel wall thickening. Most bowel tumors present as focal involvement. Segmental and diffuse thickening of bowel wall is usually caused by benign conditions.[7-8]

The ileocaecal area may be affected by a wide variety of conditions. Tuberculosis is an important cause of ileocecal wall thickening in tropical and developing countries.

Increased detection of subtle gastrointestinal tract abnormalities has been made possible by advent of multidetector CT abdomen.

This study is an endeavour to characterise the ileocaecal pathologies in patients undergoing MDCT abdomen so as to diagnose the underlying disease and help in timely management of patients.

MDCT features are important for differential diagnosis and patients can be further evaluated with ileocolonoscopy and biopsy.

6.2 REVIEW OF LITERATURE

Troppmann et al did a retrospective study in **2011** to evaluate bowel wall thickening on CT scan. 62 patients with bowel wall thickening were studied. Out of these, 21% had generalized bowel wall thickening, 58% had bowel wall thickening limited to one segment of colon, mostly left sided. 44% of patients were evaluated by endoscopy. Malignancy was confirmed histologically in 2 patients.19% had normal endoscopy and 67% showed benign findings. It was concluded that colonic bowel wall thickening is not a common finding on CT in this study. Endoscopic evaluation was done in less than 50% patients and pathological findings were detected in 80% of these patients. It was recommended that endoscopic evaluation should be performed if bowel wall thickening is reported on CT scan.[9]

Varma RU et al conducted a CT enterography study on 84 patients clinically suspected or known to have small intestinal disease. The radiologic findings were correlated with clinical, endoscopy, histopathology and operative findings. In their study, majority of the patients had non-neoplastic pathologies (79%). Neoplastic lesions were detected in 21% of the patients of which 14% were malignant. There was good correlation between CT enterography and endoscopy, histopathology and operative findings.They concluded that CT enterography should be considered as the investigation of choice for radiological evaluation of small bowel pathologies as it provides a comprehensive evaluation of the disease process.[10]

Lee et al (2012) did a study to evaluate clinical significance of large intestine wall thickening on CT. Medical records of 815 patients who had undergone endoscopy after CT scans within 1 month were reviewed retrospectively. 233 patients were included in the study. In 81.1% of cases, wall thickening was associated with abnormal endoscopic findings. The accuracy rate on diagnosis between endoscopy and CT was 63.5%. CT findings suggestive of malignancy were length of lesion<5 cm and lymph nodal enlargement. It was

concluded that endoscopic evaluation is needed in patients with bowel wall thickening in order to exclude malignancy.[11]

Zhao et al (2014) conducted a retrospective study on 141 patients with Crohn's disease and 47 patients with intestinal tuberculosis. The objective of the study was to investigate the values of clinical features and computed tomographic (CT) enterographic manifestations in the differential diagnosis between CD and ITB. Parameters were screened by logistic regression analysis.

The clinical features indicative of CD were hematochezia and perianal disease; features indicative of ITB include positive purified protein derivative skin test, occurrence of ascites, pulmonary tuberculosis, and night sweats. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of regression mathematical model established by clinical features were 94.3, 80.4, 91.0, 93.7, and 82.6%, respectively. CT enterographic manifestations indicative of CD were the involvement of the left colon, asymmetric pattern of involvement and abscess, comb sign; manifestations indicative ITB were the distribution of the lymph nodes along the right colic artery, contracture of ileocecal valve, fixed patulous ileocecal valve and lymph nodes with central necrosis The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of regression mathematical model established by CT enterographic parameters were 96.5, 93.6, 95.7, 97.8, and 89.8%, respectively. The accuracy of CT enterographic model suggested the possibility of using CT enterography as an alternative to endoscopy in the differentiation between CD and ITB.[12]

Kedia S et al (2015) conducted a study on fifty-four patients with CD and 50 patients with ITB that were later on compared. On univariate analysis, left colonic involvement, ileocecal involvement, long-segment involvement, comb sign, presence of skip lesions, involvement of ≥3 segments and ≥1-cm sized lymph nodes were significantly different between CD and ITB. On multivariate analysis, ileocecal involvement, long-segment involvement and the presence of lymph node ≥1 cm were statistically significant. Based upon the latter three variables, a risk score (with values ranging from 0 to 3) was generated, with scores

0 and 1 having specificity of 100 % and 87 %, respectively, and positive predictive values (PPV) of 100 % and 76 %, respectively, for ITB and scores 2 and 3 having specificity of 68 % and 90 %, respectively, and PPV of 63 % and 80 %, respectively, for CD. Therefore they concluded that a predictive model based on the presence of long-segment involvement, ileocecal involvement and lymph nodes sized ≥1 cm on CT could differentiate ITB and CD with good specificity and PPV.[13]

Masselli G et al (2015) conducted a study to prospectively compare the accuracies of computed tomographic (CT) enterography and magnetic resonance (MR) enterography for the detection and characterization of small bowel diseases. 150 consecutive patients (81 men and 69 women; mean age, 38.8 years; range, 18–74 years), who were suspected of having a small-bowel disease on the basis of clinical findings and whose previous upper and lower gastrointestinal endoscopy findings were normal, underwent CT and MR enterography. Two independent readers reviewed CT and MR enterographic images for the presence of small-bowel diseases, for differentiating between inflammatory and non-inflammatory diseases, and for extraenteric complications. Overall sensitivity, specificity, and accuracy, respectively, in identifying patients with small-bowel lesions were 75.9% (41 of 54), 94.8% (91 of 96), and 88.0% (132 of 150) for CT enterography and 92.6% (50 of 54), 99.0% (95 of 96), and 96.7% (145 of 150) for MR enterography. The sensitivity of MR enterography was significantly higher than that of CT enterography for the detection of both overall small bowel diseases (P = .0159) and neoplastic diseases (P = .0412) but not for the detection of inflammatory diseases (P > .99) or non-inflammatory and non-neoplastic diseases (P = .6171).[14]

Iadicola et al (2018) did a retrospective study on 40 patients complaining of abdominal pain and had undergone abdomen CT scan in which bowel wall abnormalities were found were selected. It was found that 75% of patients had a benign condition and 25% had malignant condition. In the small bowel group, 33.3% patients had ischemic disease, 33.3% an aspecific pattern, 22.2% had inflammatory disease and 11.1% were diagnosed with cancer. It was then

recommended that endoscopic evaluation should be done in all patients with intestinal wall abnormalities on CT scan, due to the increasing rate of cancer and IBD. Capsule endoscopy should be taken into account in patients presenting with severe symptoms and after a previous negative endoscopic examination.[15]

Gale et al (2017) included patients aged who underwent either CT or MR enterography and had endoscopic biopsy within 28 days of imaging. Two pediatric radiologists blinded to the histological results reviewed imaging studies and scored the bowel for the presence or absence of mural features (wall thickening >3 mm, mural hyperenhancement) and perienteric features (mesenteric hypervascularity, edema, fibrofatty proliferation and lymphadenopathy) of active disease. Mural imaging features had the highest association with active inflammation both for MR enterography (wall thickening had 80% accuracy, 69% sensitivity and 91% specificity; mural hyperenhancement had 78%, 53% and 96%, respectively) and CT enterography (wall thickening had 84% accuracy, 72% sensitivity and 91% specificity; mural hyperenhancement had 76%, 51% and 91% respectively), with perienteric imaging features performing significantly worse on MR enterography relative to CT enterography ($P < 0.001$). They concluded that mural features are predictors of active inflammation for both CT and MR enterography, while perienteric features can be distinguished better on CT enterography compared with MR enterography.[16]

Amine et al (2018) conducted a prospective study on 87 patients with GIT symptoms where CTE was performed to evaluate its possible impact on accurate diagnosis, detection of complications and consequent guidance for management planning. The study concluded an undeniable role of MDCT in diagnosing Crohn’s disease and its complications, with a proven efficacy in identifying the enteric and extra-enteric manifestations of the disease.[17]

Misra RN (2019) conducted a study on 30 patients with clinically suspected small bowel disease that underwent CT enterography using iso-osmotic mannitol as neutral enteral contrast. CT enterography

diagnoses were compared with clinical, surgical and histopathological results. Adult patients with clinically suspected small bowel disease were included in the study. A patient not consenting for imaging study as protocol, contraindication to contrast enhanced CT i.e. allergy to intravenous iodinated contrast media, pregnancy, hemodynamic instability, and renal failure, inability for sufficient breath hold, acute high-grade intestinal obstruction / perforation and acute intestinal infections are excluded. They included 30 adults presenting with clinically suspected small bowel disease. They comprised of 14 male and 16 female patients of age ranging from 16-70years with a mean age of 31.03years. Most patients belonged to the 21-30years age group. CT enterography showed a sensitivity (95.83%), specificity (100%), positive predictive value (100%), negative predictive value (85.71%), and accuracy (96.66%) in diagnosis of small bowel diseases. They concluded that CTE is a non-invasive, well tolerated and reliable imaging modality for the depiction of small-bowel diseases and it provided excellent visualization of luminal, mural and extraintestinal findings.[18]

6.3 AIMS AND OBJECTIVES OF THE STUDY

1.To characterize the ileocaecal pathologies on MDCT abdomen.

2.To correlate MDCT findings with clinical, endoscopy findings and histopathology wherever possible.

7.0 MATERIALS AND METHODS:

7.1 SOURCE OF DATA

This study will be conducted over a period of one and half year and will include patients referred for MDCT abdomen to the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana and found to have ileocaecal pathologies

7.2 METHOD OF COLLECTION OF DATA

This study will be conducted over a period of one and half year and will include patients referred for MDCT abdomen to the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana and found to have ileocaecal pathologies

Informed consent will be obtained from all the subjects /guardians before study. The clinical history regarding the onset of symptoms and examination findings would be recorded as per performa. MDCT of the patients would be performed on Siemens 128 slice CT scan machine after giving intravenous omnipaque contrast and peglac.

PREPARATION OF PATIENT

The procedure will be explained to the patient in his/her vernacular language to alleviate fear and anxiety. During the entire period of the procedure patient will be in contact with the technician/doctor by a two-way intercom system

MDCT Protocol for the image acquisition was as follow:

Scan will be performed with the patient in supine position in quiet respiration. I.V contrast study using non-ionic water soluble contrast medium will be done following plain study.

- Scan duration: 90 seconds with scanning delay time of 30 seconds for arterial phase and 60 seconds for venous phase.
- Scan area of interest: dome of diaphragm to pubic symphysis
- Direction of scan: cranio-caudal
- Collimation: 128*0.6 mm
- Pitch: 0.8 • Reconstructed Slice thickness: 1mm
- Amount of contrast given and injection rate: 1.5ml/kg body weight at the rate of 3 ml/sec
- FOV(field of view): 400-750 mm

- Current : 175Mas
- Voltage: 120 kV

Inclusion Criteria

1. Patients with ileocaecal pathologies on Multidetector Computed Tomography(MDCT) abdomen.

DURATION OF STUDY- one and a half year

STATISTICAL ANALYSIS

Data will be described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. For comparing categorical data, Chi square ($\chi 2$) test was performed and fisher exact test was used when the expected frequency is less than 5. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were also calculated. A probability value (p value) less than 0.05 will be considered statistically significant. All statistical calculations will be done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

OUTCOME: Prediction of etiology of ileocaecal abnormalities on MDCT abdomen so as to diagnose the underlying disease and contribute to timely management of patients.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

LIST OF REFERENCES

1. Macari M, Balthazar EJ. CT of bowel wall thickening: significance and pitfalls of interpretation. AJR Am. J. Roentgenol. 2001;176:1105–16.
2. Macari M, Megibow AJ, Balthazar EJ. A pattern approach to the abnormal small bowel: observations at MDCT and CT enterography. AJR Am. J. Roentgenol. 2007;188:1344–55.
3. James S, Balfe DM, Lee JK, Picus D. Small-bowel disease: categorization by CT examination. AJR Am. J. Roentgenol. 1987;148:863–8.
4. Karahan OI, Dodd GD, Chintapalli KN, Rhim H, Chopra S. Gastrointestinal wall thickening inpatients with cirrhosis: frequency and patterns at contrast-enhanced CT. Radiology. 2000;215:103–7.
5. Desai RK, Tagliabue JR, Wegryn SA, Einstein DM. CT evaluation of wall thickening in the alimentary tract. Radiographics. 1991;11:771–83.
6. Kumar A, Rana SS, Nada R, Kalra N, Sharma RK, Dutta U, et al. Significance of ileal and/or cecal wall thickening on abdominal computed tomography in a tropical country. JGH Open. 2018;3:46-51.
7. Teresa F, Maria I. Oliveira. Bowel wall thickening at CT: simplifying the diagnosis. Insights imaging. 2014;5:195-208
8. Chou CK, Wu RH, Mak CW, Lin MP. Clinical significance of poor CT enhancement of the thickened small-bowel wall in patients with acute abdominal pain. AJR Am J Roentgenol. 2006;186:491–8
9. Troppmann M, Lippert E, Hamer OW, Kirchner G, Endlicher E. Colonic bowel wall thickening: is there a need for endoscopic evaluation. Int. J. Colorectal Dis. 2012;27:601–4.
10. Varma RU, Rajpal KL, Bite NR, Shetty DS. Utility of CT enterography in the evaluation of small bowel pathologies. International Journal of Advances in Medicine. 2017;4:1328-32.

11. Lee JS, Cho JH, Kim KO, Lee SH, Jang BI. Clinical significance of the large intestinal wall thickening detected by abdominal computed tomography. Korean J. Gastroenterol. 2012;60:300–5.
12. Zhao XS, Wang ZT, Wu ZY. Differentiation of Crohn's disease from intestinal tuberculosis by clinical and CT enterographic models. Inflamm Bowel Dis. 2014;20:915–25
13. Kedia S, Sharma R, Nagi B, Mouli VP, Aananthakrishnan A, Dhingra R, et al. Computerized tomography-based predictive model for differentiation of Crohn's disease from intestinal tuberculosis. Indian J Gastroenterol. 2015;34:135-43.
14. Masselli G, Casciani E, Polettini E, Gualdi G. Comparison of MR enteroclysis with MR enterography and conventional enteroclysis in patients with Crohn's disease. Eur Radiol. 2008;18:438-47.
15. Iadicola D, De Marco P, Bonventre S, Grutta EM, Barletta G, Licari L, et al. Bowel wall thickening: inquire or not inquire? Our guidelines. G Chir. 2018;39:41-4.
16. Gale HI, Sharatz SM, Taphey M, Bradley WF, Nimkin K, Gee MS. Comparison of CT enterography and MR enterography imaging features of active Crohn disease in children and adolescents. Pediatr Radiol. 2017;47:1321-8.
17. Abd El Rasool RM, Amine SK, Nasr MA, Moustafa AM. Role of CT Enterography in the Diagnosis of Crohn's Disease. The Egyptian Journal of Hospital Medicine. 2018;72:4126-33.
18. Misra RN, Bajaj S. Role of CT enterography in evaluation of small bowel disorders. Int J Res Med Sci. 2019;7:537-43.

PROFORMA

S.NO- MRD NO-

NAME- AGE-

ADDRESS-

CONTACT NO-

CHIEF COMPLAINTS-

PAST HISTORY-

GENERAL PHYSICAL EXAMINATION-

CLINICAL DIAGNOSIS-

LAB INVESTIGATION

- Hemogram
- LFTs

- RFTs-
- ESR-
- Any other positive investigation-
- Chest Xray findings-
- Amoebic serology-
- Blood culture-
- Montoux test-
- Biochemical examination-

CECT FINDINGS

Intestinal involvement- focal/ multifocal

Average length of involved segment-focal(<5 cm)

Segmental (6-40 cm)

diffuse (>40 cm)

Region involved-

- Ileum
- Ileocecal junction
- Cecum
- Ileum and ic junction
- Cecum and ic junction
- Ileum, cecum and ic junction

Degree of thickening- <1 cm > 1 cm

Symmetrical/ asymmetrical

Pattern of enhancement of thickened wall

Lymph node- absent if present

necrosis

calcification

homogenously enhancing

size- <10 mm >10 mm

Ileocaecal valve: normal contracted patulous

Ileocaecal angle: normal obtuse right angle

Mesenteric fat stranding present absent

Abscess and sinus tracts

Fat proliferation

Solid organ abnormalities

Ascites

Peritoneal thickening- absent

If present- Diffuse-smooth

Irregular/ nodular

Omental disease- absent/ present

ENDOSCOPIC FEATURES

- Site of involvement
- Nodularity of mucosa

- Deep ulcers
- Aphthous ulcers
- Fissures
- Fistula
- Cobblestone appearance
- Stricture

HISTOLOGICAL FEATURES

Ulceration of surface epithelium

Crypts

Lymphoid aggregates

Site and type of inflammatory infiltrate

Granuloma

DIAGNOSIS

CLINICAL FOLLOW UP

INFORMED PATIENT CONSENT

Date: _____

I……..D/o, W/o, S/o……. am willing to participate in the study "**ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES**" The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

…….. ……

Signature of the Witness Signature of the patient

Name:

Signature of Candidate Signature of Supervisor

फार्म अनुमति मरीज

तिथि_____

मैं_____ नीपत्/पुत्र/ पुत्री_____ निवासी_____ इस शोधकार्य"**ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES**" शोधकार्य इस मैं हूँ। सहमत लिए के लेने भाग में करता टिपुष् मैं हूँ। तैयार से स्वेच्छा अपनी लिए के लेने भाग में/ स्वीकृति यह की हूँ करती मुझे है। गया डाला दबाव ही न और गया दिया नहीं प्रलोभन आर्थिक कोई मुझे लिए के देने विज्ञान यह की है वासविश् यह मुझे और है गया दिया कर टस्पष् देश्यउद् का शोधकार्य इस समझा में बारे के जोखिम वाले होने में शोधकार्य इस मुझे है। लिए के लाभ के मानवता और है। मामुली बहुत जोखिम यह में समझ मेरी और है गया दिया

अस्वीकृति अपनी समय भी किसी में सम्बन्ध के लेने भाग में शोधकार्य इस मैं सकता कर तव्यक्/ प्रभाव कोई पर इलाज मेरे का करने तव्यक् अस्वीकृति मेरे और हूँ सकती पड़ेगा। नहीं

_____ _____

हस्ताक्षर के गवाह
नाम:

हस्ताक्षर के रोगी/ निशान का अंगूठे
नाम:

_____
अन्वेषक के हस्ताक्षर

_____
हस्ताक्षर के विद्यार्थी

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

“ROLE OF MDCT ABDOMEN IN EVALUATION OF ILEOCAECAL PATHOLOGIES” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ